

ENVIRONMENTAL CHARACTERIZATION OF THE
NORTH ALEUTIAN SHELF NEARSHORE REGION:
ANNOTATED BIBLIOGRAPHY
AND KEY WORD INDEX

by

S. Pace

Kinnetic Laboratories, Inc.

Final Report
Outer Continental Shelf Environmental Assessment Program
Research Unit 645

March 1984

Table of Contents

	<u>Page</u>
Acknowledgements. . . . .	.477
Project Personnel.....*	.479
Introduction.....	...481
Author Index . . . . .	...482
Annotated Bibliography and Key Word Index . . . . .	.504

Acknowledgments

This project would not have been completed without the assistance of several individuals. We thank the following people, and gratefully acknowledge the appropriate agency or affiliation for their assistance during the many phases of this project;

Stephen ZimmermanNOAA/OCSEAP, Juneau
Lyman ThorstelsonNOAA/OCSEAP, Juneau

James WiseAEIDC
Lynn LeslieAEIDC

Jerry ImmMinerals Management Service
Toni JohnsonMinerals Management Service
Tom NewberryMinerals Management Service

Martha ShepardAlaska Resources Library
Mary FaberAlaska Resources Library
Delores HunterAlaska Resources Library
Kathy VitaeAlaska Resources Library

Chris BowdenHabitat Div., ADF&G, Anch.
Robin MooringHabitat Div., ADF&G, Anch.
Glenn SeamanHabitat Div., ADF&G, Anch.
Karen SaundersComm. Fish. Div., ADF&G, Anch.
Paul ArnesonGame Div., ADF&G, Anch.

Robert Gill, Jr.Migratory Birds, USF&WS, Anch.
Colleen HandelMigratory Birds, USF&WS, Anch.
Nancy StromsonRefuge Planning, USF&WS, Anch.
John StoutInformation Trans., USF&WS, Anch.

Sharon GwinnAk. Fish. Develop. Foundation

Paula JohnsonAuke Bay Laboratories, NMFS.

Byron MorrisNational Marine Fisheries Serv.

Joanna RothInst. Mar. Sci., Univ. AK.
Robert DayInst. Mar. Sci., Univ. AK.
Allen SpringerInst. Mar. Sci., Univ. AK.

Robert CimbergVTN, Oregon

Steve GrabackiDames & Moore

Project Personnel

Personnel	Assignment
Stephen Pace	Project Manager
Christina Brown	Reference and Report Preparation
Patrick Kinney	Physical Oceanography
Knut Aagaard *	Physical Oceanography
Peter McRoy *	Biological Oceanography
Samual Stoker *	Anadromous Fish, Birds, and Mammals
Stephen Jewett *	Marine Fish and Invertebrates
Donald Hood *	Geochemical Oceanography
Frank Rose *	Industrial Development
Allen Thum	Chronic & Toxic Effects
Skip Newton	Chronic & Toxic Effects
*private Consultant	

1 Introduction

The annotated bibliography and the associated Author and Key-word indices are intended to function as a stand-alone system, allowing the user to reference material according to discipline and subject matter. The Author index is complete, second authors are listed and referenced along with primary authors in alphabetical order. Key-words also are alphabetically ordered, and entries are listed by access number. Access numbers are followed by abbreviations that denote the source of the reference material. The following is a list of sources and their abbreviations;

ADF&G	Alaska Department of Fish and Game
AIL	Alaska Resources Library, Anchorage
EPA	Environmental Protection Agency
IMS-UAF	Institute Marine Science-University of Alaska, Fairbanks
INPFC	International North Pacific Fisheries Commission
LGL	Lewis, Gunn, Livingston, Ltd.
NMFS	National Marine Fisheries Service
OCSEAP-NOAA	Outer Continental Shelf Environmental Assessment Program-National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fisheries Management Council
NW&AFC	Northwest and Alaska Fisheries Center
PEEL	Pacific Marine Environmental Laboratory
RAS-UAF	Rasmuson Library-University of Alaska, Fairbanks
UAA	University of Alaska, Anchorage
USF&WS	U.S. Fish and Wildlife Service
UW	University of Washington, Seattle
Wild. Dept.-UAF	Wildlife Department, University of Alaska, Fairbanks
MMS	Minerals Management Service

Two annotations are printed to a page and are listed sequentially according to access number. To use either index, find the Author or Key-word in the appropriate index, and refer to the citation with the access number listed. To obtain a copy of the material, consult the source listed.

The material listed in this bibliography was culled from larger bodies of literature available on the Bering Sea environ and toxicity studies, and was assembled to address the specific concerns of Impact of oil and gas field development as expressed in the RFP of this project. As such, much of the collected literature extensively covers the region of the nearshore area of the North Aleutian Shelf bounded by the intertidal zone and the 50 meter depth contour. The toxicity information is not as geographically bound, and is more regional in extent.

North Aleutian Shelf Author Index

Aarset, A.V	...354
ADF&G...	002, 009
Ainley, D.G	...007
Alberts, P.H	...357. 460
Alexander, v	...058
Allen, J.S	...309
Alvarey-Borrego, s	...052
Anderson, J.W	355, 356, 464
Andrews, S.A	...431
Anon	003, 005, 009, 358
Armetta, T.M	...132
Armstrong, D.A	...001, 012
Armstrong, J.L	...012
Arneson, P.D	...010. 011
Ashwell-Erikson, S	...008. 479
Atlas, R.M	...348
Augenfeld, J.M	...355
Babcock, M.M	...470
Bailey, E.P	...028
Bailey, H.T	...347
Baines, G.A	...208
Baird, P.A	...9.* O * 200, 201
Baker, E.T	...024, 322, 430
Baker, R. C	...037
Bakkala, B.G	013, 018, 019, 251, 475, 478
Bakke, T	...453
Baltzo, C.H	...037
Barsdate, R.J	014, 021, 022, 094, 095, 096
Barton, L.H	...020, 177, 261, 332
Bartonek, J.C	027, 178, 193, 194, 195, 279, 290, 295
Bates, S	...406
Bates, T	...342
Baxter, R	...006
Bayne, B.L	...453
Beardsley, A.J	...148. 309
Beardsley, R.C	...309
Becker, P. R	...345
Beer, s	...016
Bellrose, F	...026
Benville, P.E	...415
Berg, R.S	...017
Bergeson, B	...189
Biderman, J.O	...336
Biebl, R	...015
Blanton, J.O	...309

Bi ylock, J.W. 356, 360
 Bl M. 029
 Bo e sen, C.C. 470
 Bo e rurt, W.C. 309
 Bo ile, J. 168
 Bo nr, N. 143
 Bo e an, J.H. 335
 Br d reet, K. & W. 285
 Br h sm, H.W. 032, 033, 038, 039, 040, 041, 224, 225, 268
 Br ne r, S. 168
 Br ch sen, R.W. 347
 Br ok sen, C.C. 431
 Br o e, P.F. 237
 Br ole, W.A. 154, 155
 Br ok s, J.W. 030, 031
 Br on, D.W. 396
 Bu kis, S. 061
 Bu rs, J.J. 034, 035, 036, 042, 217, 232, 233, 234, 269
 Bu rill, D.C. 023, 094, 330, 331, 346
 Bu sash, M. 276, 329, 334
 Bu ttr, M.G. 411
 Bu tan, B. 309

Caldarone, E.M. 359, 461
 Caldwell, B.A. 154, 155, 375, 376, 408
 Caldwell, R.S. 025, 359, 461
 Calkins, D.G. 220
 Ca v n, N. 33
 Cameron, J.A. 441, 442, 443
 Ca s, M.G. 470
 Caste n, M.A. 386
 Charnel, R.L. 312
 Chee x, M. 368
 Clark, J.H. 061
 Clark, R.B. 401
 C ar n, R.C. 344
 Cheatham, D.L. 361
 Clement, L.E. 446
 Chester, A.J. 389
 Cline, J.D. 046, 155, 321, 341, 342, 343, 370
 Coachman, L.K. 062, 303, 306, 308, 309, 312
 Codispori, L.A. 047, 162, 163, 164
 Cooney, R.T. 043, 044, 045
 Cortner, G.D. 056
 Costa, O.P. 340
 Coyle, K.O. 044
 Craddock, D. 333, 362
 Crecellius, E.A. 355
 Cronshaw, J. 455
 Cur, H., Jr. 321

Dahlheim, M. 032
 oames & Moor 339
 Dau, C.P. 185, 466

Fujinaga, M228
 Fukuyama, A249
 Furuya, K156

 Garshelis, D.L264
 Gentry, R.L230, 458
 Geraci, J.R459
 Getter, C.D066, 363, 380
 Gharrett, J.A133, 470
 Gibson, C.I450
 Gibson, D.D027, 283
 Gill, R.E., Jr186, 249, 267, 294, 296, 466, 472, 473
 Goering, J.J059, 060, 062, 074, 075, 076, 094, 114
 Golia, A147
 Good, A.E198
 Gordon, L.I052
 Gould, P.J187, 292
 Grant, W.S049
 Gray, R.H373
 Green, F.,374
 Griffiths, R.P375, 376, 377, 408, 409
 Gruger, E.H385, 393, 394, 395, 398
 Gundlach, E.R363, 380
 Gusey, W.F067

 Hadley, D.,447
 Haflinger, K146, 176, 256
 Haight, R.E190
 Haley, D222, 239
 Hail, J.D205, 226, 473
 Hameedi, M.J471
 Handa, N171
 Handel, C186, 249, 294
 Hanf, R.W373
 Hanna, B.M378
 Hans, C181
 Hansen, D.V310
 Hanson, J.L133
 Harbo, S.J* 036
 Harris, C.K215
 Harrison, C.S194, 197, 205, 226, 278
 Harrison, R.J184
 Harry, G.Y218
 Hartley, J.R218
 Hartt, A.C216
 Hatch, S.A199
 Hater, G.R369
 Hattori, A.*111, 112
 Hawkes, J.W379
 Hayes, M.O066, 363, 380
 Haynes, E144, 145
 Heinemann, D454
 Hellebust, J.A378
 Higgins, H.O396

Higgins, B.E.476
 Hills, S.220
 Hilsinger, J.151
 Hirano, T.320
 Hirschberger, K.475, 478
 Hoberg, M.139, 151, 255
 Hodgins, H.C.381, 393, 394, 395, 397, 398, 399, 457
 Helliday, G.H.440
 Holmes, W.N.455
 Hood, D.W.047, 063, 157, 160, 161, 162, 163, 164, 165,
 166, 167
 Hopkins, D.M.181
 Hopson, D.J.,144
 Horowitz, A.334
 Hoskin, C.M.023
 Hsiao, S. 1.372, 382, 383
 Hutchinson, T.C.378
 Hughes, S.E.143, 265
 Hunt, G.L.062, 187, 188, 189, 196, 247, 282
 Hurley, J.B.286
 Huyer, A.309

 Iizumi, H.111, 112, 113
 Incze, L.S.012, 142, 152
 Iverson, R.L.060, 062.

 Jaenicke, H.W.213
 Jewett, S.C.141, 149, 151, 368
 Johnson, B.W.236
 Johnston, M.H.368
 Jorgensen, P.L.D.267
 Jones, D.M.107
 Jones, M.M.384
 Jones, R.D.080, 081, 082, 083, 084, 085, 107, 108, 109
 110
 June, J.130, 251

 Kaiwi, J.247
 Kajimura, H.229
 Kaplan, I.R.168, 169
 Karinen, J.F.144, 403, 427, 428, 429, 432, 433, 434
 435, 436, 448, 462, 463, 470
 Karrick, N.L.385, 393, 395, 397, 398
 Katz, C.M.046, 321, 341, 342
 Kelley, J.J.160, 165, 166
 Kelley-Hansen, K.046
 Kendall, A.W.335
 Kenyon, K.W.231, 245, 271, 277, 298
 Kesse 1, B.*283
 Kiesser, S.L.,356
 Kinder, T.H.309, 310, 317, 323, 326, 327
 King, J.G.185, 298, 465, 466
 King, K.*475, 478
 Kittle, D.W.372, 383

McRoy, N093
 McKlenburg, T.A402, 403, 462
 Memoto, T156
 Merrell, T.R133. 456
 Merritt, L.B091
 Meyers, W.S132
 Michel, J066
 Mickelson, P.G404
 Miller, M.C369
 Miller, S.E360
 Miyahara, T258
 Moen, P.D422
 Mofjeld, H.O328
 Moles, D.A387. 405, 406, 407, 436, 470
 Moore, L.J0...450
 Moore, M.N453
 Moore, S.L453
 Morehouse, K.A175
 Morita, R.Y154, 155, 375, 376, 377, 408, 409
 Morrow, J.E410
 Mossman, A.S288
 Mozley, S.C411. 412
 Muench, R.D., ***413, 414
 Mullen, T.C424
 Munday, P.R214
 Myron, R.T133

 Naidu, A.S023, 416
 Nakai, T156
 Nakamura, K280
 Nebert, M014, 021, 095
 Neff, J.M464
 Neff, S.E334
 Nelson, C181
 Nelson, J226. 249
 Nelson, R265
 Nicol, J.A.C364
 Niebauer, H.J043, 060, 325
 Niggol, K223
 Nishiyama, T043
 NMFS480
 Norrell, S.A416
 NPFMC,134. 135, 136, 474
 Nunes, P. **...***** 415
 NWAFC137. 138

 O'Brien, W.J417
 O'Clair, C.E133
 OCSEAP349. 350, 351, 352, 353
 Ogi, H.192. 212, 280
 Ohlendorf, H.M279
 Ohtani, K319
 Oliver, G001
 Olla, B.360

Sandstrom, M.....18
 Sanger, G.A.....131, 89, 191, 93, 200, 201, 249, 284
 Sarvis, J.....06, 465
 Schanuelme r, L.....098, 069, 070, 071, 072, 073
 Schneider, S.....068
 Schneider, X.B.....257, 248, 282, 438
 Scholli, D.....240, 241, 439
 Schumacher, J.D.....141
 Science Applications, Inc.....083, 304, 305, 309, 310, 315, 317, 326
 Scott, G.I.....357, 403, 414, 418, 422
 Sealy, S.G.....427, 428
 Seaman, G.A.....367, 428
 Sears, H.S.....260, 300
 Sergeant, D.....190
 Shafford, P.....082, 234
 Shapiro, L.....085
 Sharma, G.....265
 Shaw, D.G.....267
 Sheils, W.E.....037
 Shimada, A.....020, 17
 Shippen, H.H.....134
 Short, F.T.....130, 80
 Short, J.W.....470
 Sigman, M.J.....046
 Silcox, R.....044
 Simpson, R.R.....174
 Skalski, J.R.....130
 Skeko I, M.S.....139
 Skrade, H.....029
 Smith, D.D.....388, 089, 179
 Smith, G.B.....061, 437
 Smith, R.L.....455
 Smith, T.G.....13
 Straughan, D.....19
 Somerton, D.A.....129
 Sows, A.L.....73
 Stahl, K.L.....346
 Steinhof, D.....363
 Stern, L.J.....460
 Stoker, S.S.....218, 126
 Straty, R.R.....487, 127, 128, 174, 309, 441, 442, 443,
 Sturges, W.....044, 445
 Swartzman, G.L.....049
 Szaro, R.C.....059
 Taber, A.....447
 Tack, S.L.....440, 254
 Takahashi, Y.....99
 Takenouti, A.....432
 Takeuchi,261
 Stern, L.J.....216
 Stoker, S.S.....125, 272, 273, 274
 Straty, R.R.....190, 211, 213, 318
 Sturges, W.....309
 Swartzman, G.L.....220
 Szaro, R.C.....460
 Taber, A.....226
 Tack, S.L.....124
 Takahashi, Y.....148
 Takenouti, A.....319
 Takeuchi,253

Tanoue, E171
 Taylor, F.H.C228
 Taylor, T.L436. 448
 Tennant, D.A389
 Thebeau, L.C066
 Thomas, R.E437. 449
 Thorsteinson, F.V258
 Thorsteinson, L.K258. 469
 Threlfall, W.281
 Tommos, K023
 Trapp, J.L291
 Tripp, R.B328. 414
 Tsujita, T192

 U.S. Interag. Task Gp . . .238

 Vanderhorst, J.R.450
 Varanasi, U396. 451, 452
 Venkatesan, M.I168. 169
 Vestal, J.R.369
 Vinter, B.V121. 252
 VTN Oregon057, 064, 123, 259

 Wahl, T.R.299
 Waldron, K.D120, 121, 122
 Walters, G.E118. 119
 Wang, R.T364
 Warner, I.M020, 117
 Wartzok, O008
 Watson, J144
 Way, S. J361
 Weber, D.D116. 260, 394, 395, 396, 397, 398, 399
 Welch, M.364
 Wencker, D.L012. 142, 152
 Wespestad, V.G177, 251
 Weston, S.C207
 Wetzel, R.G016
 Whitmore, C266
 Widdows, J453
 Wiens, J.A.9. 454
 Wilke, F.037, 228
 Williams, S.L068, 092
 Winant, C.D309
 Withrow, D.E033
 Wolman, A202, 203
 Wolotira, R.W335
 Woodruff, D.L355

 Young, A341

 Zachariassen, K.E354
 Zimmerman, S.J065. 456

North Aleutian Shelf Key Word Index

Absorbance	158, 415
Abundance	012, 018, 019, 032, 131, 145, 191, 197, 198 199, 206, 245, 251, 265
Abyssal basins	181
Aerial Survey	065
Age composition	139, 266, 472
Alaska Current	316
Alaska Peninsula	249, 297, 422, 472
Alaska Stream	156
Aleutian islands	038, 080, 279, 291, 292, 297, 298, 301, 302
Alerts	106
Algae	101, 114, 372, 373, 383
Algal blooms	058
Alkalinity	047, 052, 162
Alkenes	169
Amak Island	071, 073, 161
Amino acids	171
Ammonia regeneration	113
Amphipods	00, 276, 329, 356, 371, 390, 421, 424
Amutka Pass	160
Animal migrations	131, 145
Anthropology	106
Applegate Cove	106
Aquatic animals	411
Aquatic Plants	378
Archaeology	106
Arctic Tern	293
Aromatic hydrocarbons	025, 347, 356, 431, 437, 449, 453, 461
Avifauna	010, 011, 246, 249
Bacterial	409
Barnacle larvae	00, 364
Baroclinic transport	307, 310, 314, 316
Beach slope	065
Bearded seal	035, 042, 232, 242, 269, 474
Behavior	278, 299, 381, 394, 395, 397, 426
Beluga whale	030, 031, 041, 182, 205, 206, 207, 222, 234 235, 237, 474
Benthic algae	099
Benthic invertebrate	119, 137
Benthos	062, 079, 125, 141, 146, 149, 172, 176, 255 331, 334, 346, 348, 355, 356, 368, 388, 391 412, 434, 444
Bering Strait	0336
Bibliography	467, 474
Bioassay	436, 450
Biochemical oxidation	052
Biogeography	102, 468

Biological cover065
 Biological degradation171, 377, 392, 409, 434
 Biology063, 184, 202, 206, 210, 239, 378, 467, 469
 Biomass125, 141, 255, 282
 Biota/sediment relationship023
 Bivalves139, 255, 265, 354, 355, 366, 368, 405, 436
 446, 448, 453, 469
 Black Brant** **** 107, 108
 Bowhead whale041, 474
 Bract175
 Breeding distribution196
 Breeding ecology055, 188

 Cadmium***426, 451
 Capelin*117, 479
 Cape Peirce055
 Carbonate mineral s052
 Carbon097
 Carbon budget014, 167
 Carbon cycling016, 154
 Carbon dioxide154, 163, 164, 165, 166, 301
 Carbon dioxide production154
 Carbon isotopes079, 172
 Carbon uptake016, 086, 104
 Cetacean041, 219, 480
 Chemistry063, 157, 349
 Chionoecetes142, 144, 152, 254, 477
 Chionoecetes bairdi463
 Chlorophyll a047, 156, 159, 171, 378, 389
 Chlorophyll ratios173
 Circulation321, 327, 370, 422, 469
 Clay mineralogy023, 170, 180
 Climatology309, 324, 325, 468
 Cluster analysis118, 119
 C/N ratio153, 163
 Coal liquid373
 Coastal Alaska099, 100, 102
 Coastal circulation300
 Coastal currente314
 Coastal domain024, 053
 Coastal flow0.00 315
 Coastal habitats001, 066, 374
 Coastal species001
 Coastal zone217
 Cold Bay*048, 110, 311
 Colonies199
 Colony size196
 Commercial fisheries003, 148, 257, 263, 444, 475, 476, 477, 478,
 480
 Commercially-important species051, 445, 477
 Communities125, 146, 176
 Community Production162, 163
 Community structure133, 244, 404

Comparative cultures	106									
Continental shelf	308, 309									
Continental slope	0	306								
Cook Inlet	***	339, 341, 345, 361, 387, 388, 389, 391, 415								
Copepod	* 0	044, 371, 390, 416, 417								
Copper	022									
Crabs	0 **0	012, 025, 067, 138, 142, 144, 152, 253, 350								
		359, 402, 403, 427, 461, 462, 463, 477, 480								
Crane Cove	111. 113									
Critical habitats	066									
Cross-shelf	303									
Crustacea	012, 025, 067, 131, 138, 142, 144, 145, 152									
	253, 350, 359, 368, 371, 402, 403, 417, 424									
	427, 461, 462, 463, 469, 477, 480									
Culture methods	077									
Currents	046, 053, 305, 306, 309, 318, 319, 413, 422									
Decapod larvae	012									
Decomposition	098. 400									
Demersal fish	018, 051, 118, 119, 128, 137, 444, 475									
Denitrification	112									
Detritus	104. 355, 388									
Development	004. 005, 142, 476									
Dissolved organic carbon	158, 171, 342									
Dissolved oxygen	047. 163									
Distribution	010, 012, 018, 019, 027, 029, 030, 032, 033									
	036, 039, 040, 044, 055, 064, 101, 123, 139									
	145, 177, 178, 184, 186, 187, 188, 191, 194									
	195, 197, 198, 199, 205, 210, 217, 228, 231									
	237, 239, 243, 245, 246, 247, 250, 253, 254									
	259, 267, 268, 269, 270, 277, 282, 283, 286									
	289, 290, 291, 292, 294, 296, 297, 298, 350									
	367, 439, 456, 469, 472									
Disturbance	236. 336, 345									
Domains	326									
Drift cards	318									
Drilling mud	384									
Dye studies	318									
Ecology	007, 028, 034, 041, 054, 062, 103, 115, 184									
	188, 191, 193, 198, 201, 210, 211, 219, 221									
	229, 234, 235, 236, 244, 248, 250, 278, 280									
	284, 292, 336, 339, 350, 351, 367, 380, 399									
	400, 427, 439, 444, 469									
Ecosystem analysis	213									
Ecosystems	043, 059, 348, 350, 351, 368, 400, 401, 416									
Eddy diffusivity	024									
Eelgrass	004, 005, 014, 015, 016, 021, 048, 049, 050									
	077, 078, 081, 082, 083, 084, 085, 086, 087									
	088, 089, 091, 092, 094, 095, 096, 097, 098									
	099, 100, 102, 103, 104, 111, 112, 113, 114									
	124, 127, 166, 174, 175, 179, 350, 420									
Elders	054. 115									

Gray whale	183, 202, 203, 225, 226, 473, 474
Grazing	044
Growth	116, 129, 142, 150, 260, 365, 382, 423, 453
Growth requirements	175
Growth rates	175
Gulls	275, 281, 286, 287, 288, 293
Habitat	010, 065, 087, 186, 187, 267, 469, 470, 480
Habitat ecology	249, 285
Harbor seal	224, 226, 236, 474, 479
Heavy metal s	021, 022, 023, 330, 331, 346, 357, 362, 370 398, 416, 426, 451
Heavy mineral s	180
Herendeen Bay	249
Herring	020, 061, 117, 148, 177, 261, 263, 266, 275 441, 442, 443, 476, 479
History	004, 005, 087, 478
Horizontal distribution	121, 122, 252
Human use	098, 468
Humic acid	168
Hunting	090
Hydrocarbons	092, 168, 169, 337, 341, 343, 348, 352, 355 359, 360, 361, 366, 371, 381, 393, 401, 407 415, 419, 441, 452, 464, 470
Hydrographic structure	307, 309, 326
Hydrography	053, 060, 076, 103, 389, 422
Hydrography/suspended sediments	024
Ice	058, 309, 353, 420
Ice front	036
Ice scour	133
Ice/sediment relationship	180
Ichthyoplankton	120, 121, 122, 252
Industrial development	385
Infauna	146, 176
Infaunal distribution	255
Inorganic carbon	162, 163, 164, 165
Insects	411, 412
Interannual variability	418
intertidal habitats	065, 401, 466
intertidal invertebrates	133
Invertebrates	006, 078, 125, 146, 176, 276, 329, 352, 371 381, 391, 392, 393, 394, 395, 423, 424, 436 438, 447, 469, 470, 479
I sopod	423
Isotopes	157
I zembek Lagoon	004, 005, 014, 021, 022, 048, 050, 068, 069 070, 071, 072, 073, 074, 078, 080, 081, 082 083, 084, 085, 087, 088, 089, 090, 091, 092 093, 094, 095, 096, 097, 098, 099, 100, 102 103, 104, 105, 106, 107, 108, 109, 110, 111 112, 113, 114, 124, 166, 173, 174

497

Microbiology	349, 408
Microneckton	045
Micro-organisms	375, 376, 377, 409
Migration	109, 129, 174, 183, 185, 186, 225, 226, 246 294, 297
Mixing	***O* ..* ...** 306, 308
Model s	046, 089, 091, 303, 328, 454, 479, 480
Moltig	054, 423, 462, 463
Monosaccharides	171, 376
Mortality	028, 150, 270, 276, 281, 293, 329, 357, 367 368, 403, 412, 442, 443, 448, 455
Murres	028, 192, 454
Naphthalene	356, 387, 402, 405, 406, 461
Nelson Lagoon	080, 249, 296
Nesting	109, 185
Nitrate	156
Nitrate/carbon dioxide relations	164
Nitrogen	111, 179
Nitrogen budget	014
Nitrogen fixation	154, 377
Nitrogen requirements	113
Nitrogen uptake	089, 113, 114
North Aleutian Shelf	001, 430, 467, 468, 469
North Atlantic	311
North Pacific	311
Nutrient cycling	077, 078, 303
Nutrient-s	006, 062, 088, 089, 096, 111, 112, 113, 114 301, 358, 389
Oceanic fronts	044, 059
Oceanography	062, 063, 114, 211, 248, 295, 300, 301, 302 303, 304, 305, 306, 309, 310, 312, 313, 314 315, 316, 317, 318, 320, 321, 322, 323, 324 326, 327, 328, 349, 413, 414, 418, 422, 467 468, 469
Oil	** * , * . 186, 370, 371, 405
Oil pollution	001, 025, 229, 230, 329, 331, 332, 333, 334 335, 337, 338, 340, 341, 343, 345, 348, 349 350, 351, 352, 353, 354, 355, 356, 357, 359 360, 361, 364, 367, 568, 369, 370, 372, 374 375, 376, 378, 379, 381, 382, 383, 386, 387 388, 389, 390, 391, 392, 393, 394, 395, 396 397, 398, 399, 400, 401, 402, 403, 404, 408 409, 410, 411, 412, 413, 414, 416, 417, 419 420, 421, 423, 424, 425, 427, 428, 429, 430 431, 432, 433, 434, 435, 437, 438, 439, 440 441, 442, 443, 444, 445, 446, 447, 448, 449 450, 452, 453, 454, 456, 457, 458, 459, 460 462, 463, 465, 469, 480
Oil seep	169, 343
Oil spill	001, 066, 247, 276, 345, 347, 363, 366, 377 380, 417, 422, 455

Organic carbon content	021, 168, 170
Organic geochemistry	168
Organic matter	153
Organic nitrogen	71
Organochlorine contamination	279
Osmoregulation	174
Oxygen	164
Pacific coast	49
Pacific cod	130, 251, 475
Pacific herring roe	441, 443
Pacific Ocean	271, 385
Paralithodes camtschatica	116, 145, 253, 402, 462, 477
Parasitism	405
Partial pressure of CO (pCO ₂)	160, 161, 164, 165, 166, 167
Particulate matter	153, 171, 430
Particulate organic matter	158
Pelagic zone	131
Perturbation	88, 89
Petrel Is.	287
Petroleum	344, 359, 369, 373, 407, 415, 461, 470
Petroleum development	332, 335, 339, 341, 345, 351, 362, 370, 384, 394, 469, 471
pH	52, 162, 167
Phalaropes	287
Penology	78
Phocid seals	233
Phosphorus	21
Phosphorus uptake	95, 96
Photosynthesis	15, 16, 92, 350, 420
Physical/biological interactions	309
Physiology	338, 340, 379, 381, 390, 392, 394, 395, 396, 397, 402, 406, 422, 425, 426, 429, 432, 433, 437, 449, 453, 457, 479
Phytoplankton	58, 166, 369, 372, 382, 383, 389
Phytoplankton bloom	254
Pinkneck clam	150
Pinnipeds	230, 287
Plankton	145, 162, 172, 192, 253, 335, 352, 388, 392
Pollack	476, 479
Pollution effects	346, 349, 358, 362, 363, 364, 369, 447, 464, 476, 480
Polynuclear aromatic hydrocarbons	169
Ponds	411
Population	29, 36, 183, 184, 203, 210, 212, 228, 373
Population densities	11, 38
Population dynamics	33, 35, 37, 39, 195, 202, 213, 216, 218, 220, 227, 229, 231, 234, 235, 237, 238, 241, 249, 252, 264
Population ecology	13, 41, 86, 126, 216, 271
Population parameters	132
Port Moller	46, 154, 155, 249, 267
Port Valdez	470

Precipitation	. . . . .	311
Predation	. . . . .	128, 149, 256, 272, 448
Prey items	. . . . .	057, 479
Pribilof islands	. . . . .	279, 454
Primary production	. . . . .	047, 060, 074, 075, 076, 077, 156, 159, 160 163, 164, 165, 166, 167, 303, 369, 372, 378 383, 389, 420
Productivity	. . . . . *	059, 062, 091, 097, 100, 196, 469, 476, 480
Proposal options	. . . . . ***	003
Prudhoe Bay	. . . . .	407, 417
Puget Sound	. . . . .	050
Radon/radium exchange studies	. . . . .	157
Recruitment	. . . . . * * * . . . .	150
Red king crab	. . . . .	257, 476
Refuge programs	. . . . .	005
Regeneration	. . . . .	163
Reproduction	. . . . .	270, 273, 274, 412, 442
Research programs	. . . . .	059
Resource assessment	. . . . .	006, 138, 265, 469, 471
Respiration	. . . . .	154, 421, 422
Resuspension	. . . . . *	024, 430
Ribbon seals	. . . . .	270, 474
Ringed seals	. . . . .	035, 270, 474
River discharge	. . . . .	313
River diversions	. . . . . ~..	181
Rivers	. . . . .	075
River water distribution	. . . . .	318
Salinity	. . . . . 0 *	015, 046, 304, 428
Salinity/temperature distributions	. . . . .	318
Salmon	. . . . .	009, 031, 056, 207, 209, 211, 212, 213, 214 215, 216, 293, 347, 387, 394, 399, 405, 407 410, 431, 437, 451, 469, 476
Salmonids	. . . . .	379, 381, 396, 406, 449
Samalga Pass	. . . . .	160, 302
Sculpins	. . . . .	338, 407
Seabirds	. . . . .	007, 006, 010, 027, 028, 055, 172, 178, 187 188, 189, 191, 192, 193, 194, 195, 196, 197 198, 199, 200, 201, 246, 247, 248, 250, 267 275, 278, 279, 280, 281, 282, 283, 284, 285 286, 287, 288, 289, 290, 291, 292, 293, 294 295, 296, 297, 299, 336, 352, 404, 465, 466
Seaducks	. . . . .	284
Seagrasses	. . . . .	050, 077, 086, 092, 098, 324, 412
Sea ice	. . . . .	034, 198, 233, 240, 254, 268, 271, 285, 349 353, 434, 468, 480
Sea ice chemistry	. . . . .	157
Sea lion	. . . . .	208, 231, 386, 474, 476
Sea ls	. . . . . C *	459, 476
Sea otter	. . . . .	057, 240, 241, 244, 245, 264, 271, 340, 386 439, 474
Seasonal variations	. . . . .	316
Seaweeds	. . . . .	061, 372, 383, 391

Sediments.* * *.***.....*.*.*.*.*	023, 024, 088, 089, 103, 111, 112, 113, 139 168, 170, 180, 181, 331, 334, 341, 348, 355 356, 368, 375, 376, 377, 397, 401, 407, 409 413, 414, 416, 430, 448
Sediment sources	170
Sediment structure	255
Sediment water interaction.....	157
Seward Peninsula	279
Shellfish.....*.....*	051, 145, 432
Sheyma Island	311
Shorebirds.....	010, 011, 186, 249, 267, 283, 289, 294, 295 297, 465, 466
Shrimp.	148, 384, 387, 494, 403, 431, 450, 457, 476
Simulation	179
Smelt.....*	117
Snails.....e.....*	140, 476
Social behavior	107
Spawning,	020, 177, 261, 266
Spawning periods	121, 122, 252
Species distribution	247
Spisulapolynyma.....*	150
Spotted seal.....	008, 474, 479
Stability.....*	196
Standing stocks	099, 103, 124, 125, 146
Steller's Eiders	109
St. George Basin	012, 017, 032, 154, 258, 430, 471, 476
Stock assessment.....	261
Stone tools	106
Storm effects	053, 281
Storm waves	170
St. Paul island	311
Stratification	053
Stratum composition	065
Stress	015, 358, 400
Structural front	304, 306
Sublethal effects	329, 385, 393, 402, 406, 426, 429, 433, 446 469, 470
Submarine canyons	181
Subsistence	234
Surf clam.....*	143, 150
Survival factors	465
Suspended organic matter	342
Tagging studies	116, 129, 132
Tanner crab	012, 132, 135, 256, 476, 477
Taxonomy	152
Tectonic history	181
Temperature	015, 046, 049, 304, 325, 354, 360, 361, 387 410, 428, 447, 458
Terns	287
Thermoregulation	386
Tidal flats	416
Tides.....*	328, 414

Toluene.....	405, 406								
Total carbon dioxide.....	047, 162, 164, 167								
Toxicity.....*	025, 330, 331, 333, 334, 338, 341, 349, 350								
	355, 357, 358, 359, 361, 362, 364, 365, 368								
	371, 373, 383, 384, 390, 392, 401, 403, 405								
	407, 410, 412, 415, 417, 420, 424, 427, 429								
	431, 433, 436, 437, 438, 442, 448, 449, 450								
	451, 453, 456, 457, 459, 460, 461, 463, 470								
Trace metals.....	094, 344, 393, 395, 396, 398, 457								
Transmissivity.....	0.....158								
Transplanting.....	050								
Transport.....*	303, 322, 410, 413, 414								
Trawl surveys.....	0006, 137								
Trophic dynamics.....*	042, 191, 208, 218, 219, 220, 222, 223, 228								
	232, 233, 242, 243, 244, 245, 248, 250, 269								
	271, 272, 273, 274, 275, 278, 280, 282, 28A								
	297								
Trophic interactions.....	007, 044, 054, 057, 059, 105, 115, 127, 128								
	130, 149, 151, 182, 189, 190, 193, 196, 200								
	201, 204, 256, 264, 284, 285, 287, 288, 293								
Tufted puffin.....*	296								
Unimak island.....*	069, 070, 071, 073								
Unimak Pass.....	074, 076, 153, 156, 158, 159, 161, 305, 422								
	480								
Upwelli rig.....	160, 161, 166, 167, 301, 302								
Vertebrates.....	393								
Vertical distribution.....	121, 122, 252								
Vertical "mixing.....	156								
Volcanic ash.....	180								
Walleye pollock.....	017, 045, 121, 122, 126, 252, 475								
Walrus.....	036, 185, 221, 232, 243, 249, 268, 272, 273								
	27A, 277, 386, 474								
Water column.....	376, 377								
Water exchange.....	305								
Waterfowl.....	004, 005, 010, 011, 026, 054, 055, 068, 069								
	070, 071, 072, 073, 080, 081, 082, 083, 084								
	085, 087, 093, 107, 108, 109, 115, 175, 185								
	246, 249, 267, 275, 283, 284, 289, 290, 294								
	295, 297, 298, 365, 425, 446, 459, 460, 465								
	466, 472								
Water pollution.....	370, 384, 385, 409, 414, 426								
Weather.....	043, 048, 070, 072, 081, 082, 083, 084, 085								
	101								
Whales.....	219, 474, 476								
Wilderness study.....	004								
Wildlife.....	080, 081, 082, 083, 084, 085, 087								
Wildlife evaluation.....	048								
Wildlife habitat.....	003, 004, 005								

Wooded Islands	404
Yellowfin sole	013, 256, 262
Yukon Delta	332
Zooplankton	044, 045, 131, 142, 335, 368, 369, 371, 390 417
Zostera	015, 016, 049, 088, 089, 091, 094, 095, 096 097, 099, 100, 102, 103, 104, 112, 114, 127 179

ACCESS # : 001, IMS-UAF

CITATION : Armstrong, D., G. Oliver, and C. Manen. 1982. Coastal species and habitats. In: Draft North Aleutian Shelf Synthesis Report, Chapter 3. OCSEAP/NOAA. Juneau, Ak.

KEY-WORDS: Coastal habitats; Coastal species; Oil pollution; North Aleutian Shelf.

SYNOPSIS : This document is the product of the OCSEAP-sponsored North Aleutian Shelf Synthesis Meeting held in Anchorage, Alaska March 9-11, 1982. It considers the North Aleutian Shelf (NAS) region from Unimak Pass to Cape Newenham. Segments addressed in this document include 1) animal groups, including general biology and unique relationships to the NAS; 2) critical habitats, such as Izembek and Nelson lagoons and the area likely affected by mishaps near Cold Bay; 3) oil toxicity to selected animals and plants; 4) oil spill scenarios and their likely impact including perturbations other than oil; and 5) recommendations and research priorities.

ACCESS # : 002, ADF&G

CITATION : Alaska Department of Fish and Game. 1978. Alaska Fisheries Atlas - Volume I. ADF&G, Juneau, Ak.

KEY-WORDS: Fisheries; Life history; Management; Distribution.

SYNOPSIS : This document includes fish species accounts, management area accounts, and fish distribution maps. Fish species accounts are general life history accounts of each fish species considered and stress distribution in Alaska and the general habitat requirements of each species. Management area accounts include general descriptions of each regulatory area and specific information regarding distribution, timing and the human uses of each species within the area. Further emphasis is placed on land and water use considerations. Fish distribution maps are marked to show distribution of each species (or in some cases, group of species) throughout Alaska. Where knowledge is available, the maps show seasonal changes in distribution, spawning areas, rearing areas, and major commercial fishing areas.

ACCESS # : 003, WILDL. DEPT.-UAF

CITATION : Anon. 1979. Proposed Alaska Peninsula National Wildlife Refuge. United States Dept. of the Interior. Environmental Impact Statement. Draft, 277 pp.

KEY-WORDS: Proposal options; Wildlife habitat; Commercial fisheries; Geology.

SYNOPSIS : The importance of the Alaska Peninsula to local wildlife is stressed. Various management options are reviewed and impact of inclusion and exclusion of several areas is discussed. There is a fairly detailed presentation of the geology, vegetation, and wildlife found on the peninsula. Maps and data depicting proposal options, oil and gas potential, mining claims, minerals, vegetation, wildlife, marine mammals, fish, and birds are included. There are some data concerning human populations and commercial fish and shellfish catch.

ACCESS # : 004, RAS-UAF

CITATION : Anon. 1970. Izembek Wilderness Proposal. United States Fish and Wildlife Service. 21 pp.

KEY-WORDS: Wilderness study; Wildlife habitat; Development; History; Eelgrass; Izembek Lagoon.

SYNOPSIS : A summary of the Izembek wilderness study, this publication is intended to determine the suitability of including all or part of the refuge in the National Wilderness Preservation System. The history of the area is described along with some data on current weather patterns and general physical characteristics. Animal populations are described with particular emphasis on birds and large mammals. The major value of the area lies in the food resources associated with the eel grass beds of the lagoon. Proposed development includes a marine lab, two shelters and a trail system. The tidal area is inseparable ecologically from the terrestrial and oil or gas development is predicted to have serious consequences on the food base for the area and offshore fisheries.

ACCESS #: 005, RAS-UAF

CITATION : Anon, 1969. Izembek National Wildlife Range. United States Dept. of the Interior. Fish and Wildlife Service. 25 pp.

KEY-WORDS: Refuge programs; Wildlife habitat; History; Development; Waterfowl; eelgrass; Izembek Lagoon.

SYNOPSIS : This report is designed to promote public understanding of the Izembek Refuge program. It includes a brief history of the area, including anthropological and geological information. The extensive eelgrass beds of the lagoon are cited as the primary food base for a diversity of wildlife. The area is thought to be a refuge for the endangered Aleutian Canada Goose. A limited trail system is proposed along with two rustic shelters for wildlife observation.

ACCESS # : 006, IMS-UAF

CITATION : Baxter, R. 1976. Inshore Marine Resources, Bristol Bay, Alaska. Unpublished report. Alaska Department of Fish & Game, Box 96, Bethel, Ak. 99559.

KEY-WORDS: Resource assessment; Longline; Fisheries; Marine mammals; Seabirds; Invertebrates; Trawl surveys.

SYNOPSIS : This document provides information on the potential commercial fisheries within the 12-mile contiguous fishery zone of Bristol Bay and lower Kuskokwim Bay. Sampling was conducted during 1974-75 by trawling, longlining, clam surveys, and beach surveys. There were only two organisms noted that would support a major commercial fishery; the herring and the capelin. In addition to information presented on these two potential commercial species, data are presented on marine mammals, seabirds, marine fishes, mollusks, crustaceans, and echinoderms.

ACCESS # : 007, WILDL.DEPT.-UAF

CITATION : Ainley, D.G., and G.A.Sanger. 1979. Trophic relations of seabirds in the northeastern Pacific Ocean and Bering Sea.USF&WS,Wildl. Res. Rep. 11: 95-112.

KEY-WORDS: Seabirds; Trophic interactions; Ecology.

SYNOPSIS : A review of literature on the diets and feeding habits of seabirds of the northeastern Pacific Ocean and Bering Sea, with broad characterizations of the diets of major species.

ACCESS # : 008, IMS-UAF

CITATION : Ashweii-Erickson, S., R.Elsner, and D. Wartzok. 1978. Metabolism and nutrition of Bering Sea harbor and spotted seals. Cont. No. 30. inst. Mar. Sci., Univ. Alaska, Fairbanks. 22 pp.

KEY-WORDS: Harbor seal; Spotted seal; Nutrition; Feeding; Metabolism; Marine mammals.

SYNOPSIS : A report and discussion of the results of laboratory observations of captive harbor and spotted seals is presented here. Metabolic rates and nutritional requirements are described by age group. Food requirements of spotted seals seems to decline from 13% of body weight per day during the first year to 3% per day at age nine.

ACCESS # : 009, ADF&G

CITATION : ADF&G. 1983. Annual management report, 1982, Bristol Bay area. ADF&G, Div. Comm. Fish. Ann. Rep. 213 pp.

KEY-WORDS: Salmon; Fisheries management.

SYNOPSIS : This is the latest of 23 such reports detailing management activities of the ADF&G, Div. of Comm. Fish. in the Bristol Bay area. Extensive data are presented relating to fisheries effort, catch, escapement, and return. Data are presented by area and by year, including 1982 results. Though the 1982 sockeye run of 22.2 million fish was lower than the predicted 34.6 million, it was considerably higher than runs of recent years, with a harvest of 15.1 million fish, or triple the average cycle year since 1956.

ACCESS # : 010, RAS-UAF

CITATION : Arneson, P.D., 1980. identification, documentation and delineation of coastal migratory bird habitat in Alaska. Final Report of Principal investigators. 350 pp. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Seabirds; Waterfowl; Shorebirds; Avifauna; Habitat; Distribution.

SYNOPSIS : This report is based primarily on the results of 33 coastal surveys flown between October, 1975 and August, 1978. Areas assessed were the northeast Gulf of Alaska, Kodiak Island, Lower Cook inlet, the northern Alaska Peninsula, northern Bristol Bay, and the Aleutian Shelf. For each area information is presented as to species abundance, spatial and temporal distributions, habitat preference, critical habitats, migratory routes and breeding locales, and vulnerability to oil spills. Estuaries on the north side of the Alaska Peninsula had the greatest bird densities of any region surveyed. In spring, geese, sea ducks, gulls, and dabbling ducks were found in abundance. In fall, these same species were in abundance in addition to large shorebird populations. Several unique bird species use these estuaries exclusively for migration staging, and would be particularly vulnerable to oil spills. Shearwaters were particularly abundant at the southern end of the peninsula in summer, while in winter sea ducks were found in both lagoon and exposed inshore habitats.

ACCESS # : 011, ADF&G

CITATION : Arneson, P.D. 1978. Identification, documentation and delineation of coastal migratory bird habitat in Alaska. ADF&G. Annual Report. 51pp. Anchorage.

KEY-WORDS: Avifauna; Population density; Waterfowl; Shorebirds.

SYNOPSIS : This report summarizes results of aerial surveys of Bristol Bay and Cook Inlet during May, 1977, and the winter of 1977-78, respectively. Along the Alaska Peninsula and within northern Bristol Bay, all protected waters (bays, lagoons, and estuaries) were densely populated by a wide variety of staging birds during the spring migration. However, each locale seemed to offer slightly different types of habitat and to support different species compositions. Near-shore subtidal, littoral, and supralittoral zones were all very important foraging and roosting areas. Brant were the most numerous bird recorded. This species was found in eelgrass beds of Izembek Lagoon and adjacent estuaries. The next most abundant species, Emperor Geese, preferred sandspits and mud/sand flats with associated Intertidal area from Cinder River to Izembek. Shorebirds, though not as abundant as during the fall migration, were recorded in large numbers in several of the estuaries.

ACCESS #: 012, IMS-UAF

CITATION : Armstrong, D.A., L.S. Incze, J.L. Armstrong, D.L. Wencker, and B.R. Dumbauld. 1981. Distribution and abundance of decapod crustacean larvae in the S.E. Bering Sea with emphasis on commercial species. Principal Investigators' Reports for the Year Ending March 1981. Vol. 11. pp. 365-596. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Decapod larvae; Distribution; Abundance; King Crab; Tanner crab; Crabs; Shrimps; St. George Basin; Crustacea.

SYNOPSIS : This document presents data on distribution and abundance of the larvae of king crab, Tanner crab, other brachyuran crabs, and hermit crabs, and shrimps with emphasis on panda lid species. Zooplankton data presented were collected during the years 1976 thru 1980. Results are considered in a general discussion on oil impact, with emphasis given to pollution originating in the St. George Basin.

ACCESS #: 013, IMS-UAF

CITATION : Bakkala, R.G. 1981a. Population characteristics and ecology of yellowfin sole. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 1: 553-574. NOAA, Distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Population ecology; Yellowfin sole.

SYNOPSIS : This document presents information on the population structures ecology, and environmental influences of the yellowfin sole in the eastern Bering Sea. Population structure information includes stock biomass and structure, size and age composition, size and age at maturity and recruitment to the fishery, length-weight relationships, growth, and mortality. Population ecology examines species interactions and distribution and seasonal movements. Climatic variations examines year-class strength in conjunction with warm or cold years and ice cover.

ACCESS # : 014, IMS-UAF

CITATION : Barsdate, R.J., M. Nebert and C.P. McRoy. 1974. Lagoon contributions to sediments and water of the Bering Sea. in: D.W. Hood and E.J. Kelley (eds.), Oceanography of the Bering Sea. Occ. Pub. No. 2. Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp. 553-576.

KEY-WORDS: Izembek Lagoon; Eelgrass; Carbon budget; Nitrogen budget; Bering Sea.

SYNOPSIS : The eelgrass (Zostera marina L.) meadows of Izembek Lagoon annually produce 166,000 mt of carbon, 7400 mt of nitrogen, 1660 mt of phosphorus, 386 mt of silica and 3.45 mt of copper. Only a small fraction of the total production appears to be recycled within the lagoon. Avian herbivory accounts for no more than 3% of the total annual production, while decomposition leaching of beached grass is perhaps less than 0.1%. Detached, floating eelgrass appears to gain rather than lose nitrogen, phosphorus, copper and silica in transit from the lagoon, but the overall quantities involved are negligible. In addition to elements incorporated in detached, floating eelgrass, the lagoon exports substantial quantities of dissolved carbon, nitrogen and phosphorus. Dissolved copper and silica, on the other hand are lost to the lagoon from the Bering Sea at annual rates which may exceed 200 mt of copper and 600 mt of silica. Lead is also removed from the Bering Sea but in somewhat smaller quantities. The fixed carbon and elements of seagrasses that are eventually incorporated in the detrital organics of Bering Sea sediments may form an important component of Bering Sea food webs.

ACCESS # : 015, IMS-UAF

CITATION : Biebl, R. and C.P. McRoy. 1971. Plasma-tic resistance and rate of respiration and photosynthesis of *Zostera marina* at different salinities and temperatures. *Marine Biol.* 8(1): 48-56.

KEY-WORDS: Salinity; Temperature; Stress; *Zostera*; Eelgrass; Photosynthesis.

SYNOPSIS : Two different forms of *Zostera* from tidal and subtidal habitats are exposed to various salinities and temperature. Experiments are performed using leaf pieces and respiration and photosynthesis are measured through changes in water column oxygen concentrations. Daily maximum temperatures from Izembeck are reported. Intertidal plants experience summer fluctuations from 10-30 degrees C. *Zostera* survived well in 0-3x normal sea water concentrations. Plants died in 4x sea water. Respiration was depressed in distilled water. There was no difference between subtidal and intertidal plants. Maximum rates of photosynthesis were observed in 1x sea water, and decreased to near zero levels at both higher and lower salinities. Respiration increased when temperatures were increased from 0 degrees C. Tidal plants showed a slightly better tolerance for high temperatures. Ranges of temperature tolerance are reported, along with positive net production.

ACCESS # : 016, IMS-UAF

CITATION : Beer, S. and R.G. Wetzel. 1982. Photosynthetic carbon fixation pathways in *Zostera marina* and three Florida seagrasses. *Aquat. Bot.* 13: 141-146.

KEY-WORDS: Photosynthesis; Carbon uptake; Eelgrass; *Zostera*.

SYNOPSIS : *Zostera* from Izembek Lagoon is compared with *Thalassia*, *Syringodium*, and *Halodule* from the Gulf of Mexico. Plants are exposed to short term (5 us) pulses of ^{14}C and initial fixation products assessed as per cent of total label. Little label is incorporated into malate, suggesting that the seagrasses are using the C_3 pathway for carbon fixation. A table of labeled sugars from all plants is presented.

ACCESS # : 017, ARL

CITATION : Berg, R.J. 1977. An updated assessment of biological resources and their commercial importance in the St. George Basin of the eastern Bering Sea. Principal Investigators' Reports for the Year Ending March 1977. Vol. 1. pp. 555-680. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Fishery resources; Fisheries; Environmental legislation; Walleye pollock; St. George Basin.

SYNOPSIS : The Bering Sea, in general, is one of the richest fish producers in the world, second only to the North Sea in terms of demersal fish yields. The present target species of fish in the eastern Bering Sea fishery is the Pacific (walleye) pollock (*Theragra chalcogramma*). Pollock undergo temperature-related seasonal migrations concentrating in shallower waters of the shelf in warm seasons, but moving to deeper waters of the shelf and slope in cold seasons. Spawning by pollock occurs northwest of Unimak Island in May. Eggs are pelagic and concentrated along the continental shelf in the upper waters layers. The St. George Basin is an important pupping and rearing area for many seasonal and resident marine mammal species. The largest northern fur seal herd in the world reproduces on the Pribilof islands. Considering the importance of the southeastern Bering Sea, including the St. George Basin area, as a protein producer, the primary recommendation of the National Marine Fisheries Service is: establishment of a marine sanctuary in the southeastern Bering Sea, including Bristol Bay and the St. George Basin area, bounded on the west generally by the 100-fm contour, under the provisions of Title III of the Marine Protection, Research, and Sanctuaries Act of 1972 (PL 92-532).

ACCESS # : 018, NMFS

CITATION : Bakkala, R.G. and G.B. Smith. 1978. Demersal fish resources of the eastern Bering Sea: Spring 1976. Northwest and Alaska Fisheries Center, NOAA. 234 pp.

KEY-WORDS: Demersal fish; Distribution; Abundance; Fisheries resources.

SYNOPSIS : During the spring months of 1976, a large-scale and multi-vessel demersal trawl survey was conducted in the eastern Bering Sea. A total of 683 otter trawl samples was collected within a study area of 337,930 km². This was the second of two baseline surveys designed to describe characteristics of Bering Sea demersal fish and shellfish populations. The first large-scale survey had been conducted during August-October 1975. Little information is included pertaining to waters inside the 50 m contour of the eastern Bering Sea.

ACCESS # : 019, NMFS

CITATION : Bakkala, R. 1981b. Pacific cod of the eastern Bering Sea. (Document submitted to the annual meeting of the International North Pacific Fisheries Commission, Vancouver, Canada, Oct. 1981) Northwest and Alaska Fisheries Center, NMFS, NOAA, Seattle, WA. 49 pp.

KEY-WORDS: Pacific cod; Distribution; Abundance; Fisheries resources.

SYNOPSIS : This document examines the history of biological studies and commercial fishery on Pacific cod in the eastern Bering Sea. Little information is included pertaining to waters inside the 50 m contour of the eastern Bering Sea.

ACCESS #: 020, IMS-UAF

CITATION : Barton L.H., I.M. Warner, and P. Shafford. 1977. Herring spawning surveys - southeastern Bering Sea. Final Reports of Principal Investigators. vol. VII. pp. 1-112. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Herring; Spawning; Fisheries.

SYNOPSIS : This report presents data from surveys conducted from Unimak Pass to the Yukon River Delta. The spatial and temporal distribution of Pacific herring and other forage fishes are presented, including the major spawning areas. The importance of herring to domestic users is also documented. Regarding oil exploration and leasing activities, the document maintains that the geological and climatological characteristics associated with most herring spawning habitats encountered in the study area may preclude effective cleanup and containment activities associated with oil spills.

ACCESS # : 021, IMS-UAF

CITATION : Barsdate, R.J., M. Nebert, and C.P. McRoy. 1972. Lagoon contributions to sediments and water of the Bering Sea. In: D.W. Hood and E.J. Kelley (eds.), Oceanography of the Bering Sea. Occ. Pub. No. 2, Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp. 553-576.

KEY-WORDS: Eelgrass, Phosphorus; Elemental export; Lagoons; Izembek Lagoon; Nitrogen; Organic carbon; Heavy metals.

SYNOPSIS : Data presented here give rates of export of reactive phosphorus to the Bering Sea (495 mt/yr). The amounts of various elements incorporated into eel grass in Izembek Lagoon are given.

ACCESS # : 022, IMS-UAF

CITATION : Barsdate, R. 1971. Distribution of copper and lead in the southeast Bering Sea and adjacent areas. In: Oceanography of the Bering Sea, Phase 1. Turbulent upwelling and biological productivity mechanisms in the Southeastern Bering Sea and Aleutian islands. D.W. Hood et al. Report No. R-71-9. Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp. 64-71.

KEY-WORDS: Copper; Lead; Heavy metals; Izembek Lagoon; Upwelling.

SYNOPSIS : Concentration of 0.5 to 0.6 ug/l of dissolved copper and 0.1 to 0.2 ug/l of dissolved lead were found in Izembek Lagoon whereas concentrations of 1.8 to 3.3 ug/l of copper and 0.3 to 1.0 ug/l of lead were found in near shore Bering Sea samples. A plume of low values for both elements was observed west of Izembek Lagoon. Just off Unimak Island indicate a net loss of these elements to the Izembek Lagoon. Probably 1 metric ton of copper is lost each day.

ACCESS # : 023, ARL

CITATION : Burrell, D.C., K. Tommos, A.S. Naidu, and C.M. Hoskin. 1981. Some geochemical characteristics of Bering Sea sediments. [in: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 1: 305-319. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Sediments; Grain size distribution; Biota/sediment relationship; Heavy metals; Clay mineralogy.

SYNOPSIS : In the nearshore region north of the Alaska Peninsula the sediments are 50 to 90% sand-sized with occasional gravel spots extending to as much as 40% of the surficial sediments. Clay-sized sediments are usually less than 10%. The presence of macrobenthos individuals showed a maximum in a grain size mode of between 125 and 150 μ m (fine sand). Trace metal content of particulate matter show highly significant correlations for structural alumina-silicate elements: Al, Fe, Ca, Co. Some data for mean elemental particulate and soluble contents of Bering Sea water are given.

ACCESS # : 024, PMEL

CITATION : Baker, E.T. 1981. North Aleutian Shelf Transport Experiment. 'Annual report of Pacific Marine Environmental Laboratory/NOAA, Seattle. Contract No. R7120897. 61 pp.

KEY-WORDS: Suspended particulate matter" (SPM); Sediments; Hydrography/suspended sediments; Eddy diffusivity; Resuspension; Coastal domain.

SYNOPSIS : Data from both the North Aleutian Shelf (NAS) area and the St. George Basin area showed a close relationship between suspended particulate matter distributions and hydrographic properties such as temperature and salinity. SPM landward of the 50 m isobath (the coastal domain) was generally well mixed throughout the water column. SPM profiles seaward of the 50 m isobath always consisted of surface and near bottom maxima separated by a uniform, low concentration zone. Frontal regions were characterized by relatively low values of SPM concentration in the near bottom layer. Particle size distributions indicated that surface and near bottom SPM populations were distinct seaward of the coastal domain. Estimates of the vertical eddy diffusion coefficient made from the SPM profiles showed that the bottom layer is a zone of energetic turbulent mixing capped by a thinner layer of much lower eddy diffusivity. The coastal domain north of the Alaskan Peninsula was found to have a sigma T of usually less than 24 in the summer and was well mixed from top to bottom. The coastal domain is characterized by uniform vertical SPM profiles and similar particle size distribution throughout the water column, both features resulting from a well mixed water column where the primary particle source is bottom resuspension. The light attenuation values (method for measuring SPM) were highest near shore (1.4 to 2.8/m) decreasing to < 1.0 beyond the 50 m isobath.

ACCESS # : 025, ARL

CITATION : Caldwell, R.S. 1976. Acute and chronic toxicity of seawater extracts of Alaskan crude oil to zoeae of the Dungeness crab, Cancer magister Dana. Principal Investigators Reports for the Year Ending March 1976. Vol. 8. pp. 345-375. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Environmental effects; Oil pollution; Toxicity; Aromatic compounds; Crabs; Crustacea.

SYNOPSIS : The full strength seawater soluble fraction of Cook Inlet crude oil is acutely toxic to first instar C. magister larvae but no lethal or sublethal effects were found of an continuous exposure period. In similar long-term exposures, 0.16 ppm naphthalene, the highest concentration tested, is also without effect on the larvae but 7.2 ppm benzene and possible also 1.4 ppm benzene result in reduced larval survival. The effects of benzene appear to be manifested at the time of the first zoeal molt in these long-term exposures. A comparison of the lethal concentration of benzene with the estimated concentration of this aromatic compound in the full strength seawater soluble fraction of crude oil suggests that benzene may account for a major portion of the toxicity of this fraction. Since the concentrations of many of the seawater extractable components of crude oil may be expected to decline rapidly under natural environmental conditions as a result of dilution, evaporation, and metabolism by microorganisms, these studies suggest that crude oil contaminations of seawater may not seriously affect decapod larvae as long as the larvae do not contact the oil/water interface.

ACCESS # : 026, RAS-UAF

CITATION : Bell rose, F. 1976. Ducks, Geese, and Swans of North America. Stackpole Books. Harrisburg, Pa., 544 pp.

KEY-WORDS: Ducks; Swans; Geese; Waterfowl; Ecology.

SYNOPSIS : Species accounts are presented by chapter, which include distribution, population status, migration routes and timing, habitats, feeding behavior, breeding biology, mortality and disease, and management.

ACCESS # : 027, RAS-UAF

CITATION : Bartonek, J.C., and D.D. Gibson. 1972. Summer distribution of pelagic birds in Bristol Bay, Alaska. Condor 74: 416-422.

KEY-WORDS: Distribution; Seabirds.

SYNOPSIS : Authors relate marine bird distributions as observed in Bristol Bay during the summer of 1969. The most common species observed were Shearwaters, Black-legged Kittiwakes, and Common Murres.

ACCESS # : 028, RAS-UAF

CITATION : Bailey, E.P., and G.H. Davenport. 1972. Die-off of Common Murres on the Alaska Peninsula and Unimak Island. Condor 74: 215-219.

KEY-WORDS: Murres; Seabirds; Mortality; Ecology.

SYNOPSIS : Authors describe a mass die-off of some 68,000 to 100,000 Common Murres along the coast of the Alaska Peninsula and Unimak Island in April of 1970. First attributed to an unknown oil spill, mortality was later attributed to starvation due to adverse weather conditions.

ACCESS # : 029, ARL

CITATION : Bureau of Land Management. 1981. Marine mammals. In: Draft EIS for the proposed OCS oil and gas lease sale, St. George Basin. pp. 53-66. U.S. Dept. Int. Washington, D.C.

KEY-WORDS: Marine mammals; Populations; Distribution.

SYNOPSIS : The general biology and population status are reviewed from available literature sources, for northern fur seal, Steller sea lion, harbor seal, and sea otter. Spotted seals, ribbon seals, and 16 species of cetaceans are also described as occurring within the lease area.

ACCESS # : 030, ADF&G

CITATION : Brooks, J.W. 1955. Beluga investigations. ADF&G Ann. Rep. for 1955. pp. 98-106. ADF&G, Juneau.

KEY-WORDS: Beluga whale; Distribution; Feeding; Fisheries management; Marine mammals.

SYNOPSIS : From May to August, 1954 and 1955, 116 belugas were collected in Kvichak and Nushagak Bays for stomach analysis. An average of 685 red salmon fingerlings were found per stomach during the seaward smelt migration in May and June. Although beluga do eat some adult salmon, the predation loss of juveniles is considered more substantial and serious.

ACCESS # : 031, ADF&G

CITATION : Brooks, J.W. 1954. Beluga. ADF&G Annual Rep. for 1954. ADF&G, Juneau. pp. 51-57.

KEY-WORDS: Belugawhale; Salmon; Fisheries management; Marine mammals.

SYNOPSIS : The author describes beluga *as* common in Nushagak Bay and the mouth of the Kvichak River during red salmon migrations. After 30 May when the salmon smelt migration began, an average of 390 fingerlings were found per stomach from 68 belugas collected.

ACCESS # : 032, ARL

CITATION : Braham, H.W., and M.E. Dahlheim. 1981. Marine mammal resource assessment for the St. George Basin, Bering Sea, Alaska: an overview. Draft rep. NMML, NWAFC, NMFS/NOAA.

KEY-WORDS: Marine mammals; Distribution; Abundance; St. George Basin.

SYNOPSIS : Estimates of population size in the southeastern Bering Sea and the North Pacific are given for 15 cetacean species, for northern sea lion, for walrus, and for fur, harbor, spotted, ringed, bearded, and ribbon seals. Migration and distribution patterns in the southeastern Bering Sea, as indicated from published reports and unpublished sightings, are described and mapped for each species.

ACCESS # : 033, NW&AFC

CITATION : Braham, H.W., R.D. Everitt, B.D. Krogman, D.J. Rugh, and D.E. Withrow. 1977. Marine mammals of the Bering Sea: a preliminary report on distribution and abundance. 1975-76. U.S.D.C., NOAA/NMFS., NW & Ak. Fish. Cent., Mar. Mammal Div., Seattle, Wash. Processed Rep. 90 pp.

KEY-WORDS: Marine mammals; Population dynamics; Distribution.

SYNOPSIS : Based on aerial surveys conducted between June, 1975 and October, 1976, information is presented on distribution and abundance of ringed seals, bearded seals, spotted (larga) seals, ribbon seals, walrus, Steller seal lions, and cetaceans. During winter, spotted were the most numerous species in Bristol Bay, followed by bearded, ringed, and ribbon seals. Cetaceans sighted included gray whales, fin, minke, sei, killer and goosebeaked whales, and harbor and Dall porpoises.

ACCESS # : 034, RAS-UAF

CITATION : Burns, J.J., L.H. Shapiro and F.H. Fay. 1977. The relationships of marine mammal distributions, densities and activities to sea ice conditions. Principal Investigators? Reports for the Year Ending March 1977. Vol. 1. pp. 503-554. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Marine mammals; Sea ice; Ecology.

SYNOPSIS : Based on satellite imagery, aerial surveys, and ship surveys, authors describe occurrence, duration and interrelationships of ice conditions in 20 areas of the winter pack, define location and structure of the spring ice front, and describe seasonal and spatial distribution of marine mammals in relation to ice conditions. Bearded seals, ringed seals, ribbon seals, spotted seals and walrus are seasonally present in the Bristol Bay vicinity, with densities and distributions governed by the extent of winter ice. Ringed seals are sparse south of Norton Sound; ribbon seals are generally west of the Pribilof Islands; bearded seals are uniformly distributed throughout the ice front; walrus are clumped within the ice front, particularly in northern Bristol Bay; spotted seals are broadly distributed in the ice front, with highest concentrations near Bristol Bay. As ice retreats, many spotted seals remain in Bristol Bay, moving into the ice-free coastal zone. Spotted seals, bearded seals and ribbon seals all pup in the ice front from February until May, depending on species.

ACCESS # : 035, RAS-UAF

CITATION : Burns, J.J., and T.J.Eley. 1977. The natural history and ecology of the bearded seal (Erignathus barbatus) and the ringed seal (Phoca (puss) hispida). Principal investigators! Reports for the Year Ending March 1977. Vol. 1. 226-302. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Bearded seal; Ringed seal; Population dynamics; Ecology; Marine mammal is.

SYNOPSIS : The bulk of this report concerns ringed seals. The report presents data on the distribution and abundance of ringed and bearded seals based on aerial surveys of March and April, 1977 and June, 1977 and discusses ringed seal taxonomy, pelage, dentition, growth rates, productivity, predation, sex and age composition and density. The report also presents data on subsistence harvests of ice-associated marine mammals. The authors state that both ringed and bearded seals are seasonally present in northern Bristol Bay, with numbers and distributions dependent on extent of winter ice.

ACCESS # : 036, RAS-UAF

CITATION : Burns, J.J., and S.J.Harbo, Jr. 1977. An aerial census of spotted seal, Phoca vitulina largha, and walruses, Odobenus rosmarus, in the ice front of the Bering Sea. Quarterly Reports of Principal investigators. Vol. 1. pp. 58-132. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Seals; Walrus; Marine Mammals; Population; Distribution; ice front.

SYNOPSIS : Based on 24 aerial surveys conducted during March and April, 1976 and 1977, spotted seals and walrus are described as occurring throughout the front, with large concentrations of both species in central and western Bristol Bay.

ACCESS # : 037, RAS-UAF

CITATION : Baker, R.C., F. Wilke, and C.H. Baltzo. 1970. The northern fur seal. U.S. Fish & Wildl. Serv. Circ. #336. 20 pp.

KEY-WORDS: Fur seal; Marine mammals; Population dynamics; Ecology.

SYNOPSIS : Author's abstract: "The early history of worldwide fur sealing; the distribution and movement of northern fur seals; and their food, physical characteristics, reproduction, and mortality and disease are discussed. Information is also given on fur seal population, management, and research; sealing on the Pribilof Islands; and processing and sale of fur seal skins." Authors state that when away from the rookery seals remain at sea, generally 10 to 90 miles offshore.

ACCESS # : 038, RAS-UAF

CITATION : Braham, H.W., R.D. Everitt, and D.J. Rugh. 1980. Northern Sea lion population decline in the eastern Aleutian Islands. J. Wildlife Management. 44: 25-33.

KEY-WORDS: Mammals; Sea lions; Aleutian Islands; Population densities.

SYNOPSIS : Authors estimate based on the results of 6 aerial surveys from June, 1975 to June, 1977, that the sea lion population of the Unimak Island-Amak Island vicinity is currently (as of 1977) less than 25,000 down from over 50,000 in the late 1950's and early 1960's. Though no conclusions are drawn as to the cause of this decline, possibilities offered are increased disease (Leptospira pomona), increased competition from commercial fisheries in the area, and commercial harvesting of pelts from 1970 through 1972.

ACCESS #: 039, ARL

CITATION : Braham, H.W., and D. Rugh. 1978. Baseline characterization of marine mammals in the Bering Sea: distribution and abundance. Principal Investigators' Reports for the Year Ending March 1978. Vol. 1. pp. 1-14. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Marine mammals; Population dynamics; Distribution.

SYNOPSIS : This is a quarterly report which updates results of the authors' earlier study concerning a population decline of northern sea lions in the eastern Aleutian Islands. They report that the decline occurred prior to exploration of the Saint George, Aleutian Shelf, and Bristol Bay oil lease tracts. These areas are identified as highly important because of their proximity to the sea lions' breeding grounds. Gray whale movements through Unimak Pass are also described.

ACCESS # : 040, RAS-UAF

CITATION : Braham, H.W., C. Fiscus, and D. Rugh. 1977. Marine mammals of the Bering and southern Chukchi Seas. Principal Investigators' Reports for the Year Ending March 1977. Vol. 1. pp. 1-99. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Marine mammals; Distribution; Population status.

SYNOPSIS : Population estimates and spatial and temporal distribution patterns are described, based on the results of aerial surveys, for bearded seals, spotted (largha) seals, harbor seals, ribbon seals, ringed seals, Steller sea lions, and various cetaceans in the Bering and southern Chukchi Seas. Results indicate that the distribution, both spatial and temporal, of bearded seals, ribbon seals, spotted seals and ringed seals is primarily dependent on seasonal ice conditions. All of the above species, in addition to walrus, frequent northern Bristol Bay during the winter, with numbers and distribution governed by the extent of sea ice. The population of Steller sea lions in the northeast Aleutian-Bristol Bay area is estimated at 23,000, down approximately 50% from the late 1950's. About 80% of this population frequents rookeries in the Fox Islands, 20% utilizes Amak Island. The harbor seal population is estimated at around 30,000 for the northeast Aleutian-Bristol Bay area, with 80% frequenting 5 hauling areas. The most common cetaceans observed, excepting beluga and bowhead whales, were Dan porpoise and Minke whales. Other common species were gray whales, killer whales, and fin whales.

ACCESS # : 041, IMS-UAF

CITATION : Braham, H.W., and B.D. Krogman. 1977. Population biology of the bowhead (*Balaena mysticetus*) and beluga (*Delphinapterus leucas*) whale in the Bering, Chukchi, and Beaufort Seas. U.S. Dept. Comm., NOAA/NMFS. NW & Alaska Fish. Center, Seattle. 29 pp.

KEY-WORDS: Bowhead whale; Beluga whale; Population ecology; Cetacean; Ecology; Marine mammals.

SYNOPSIS : A review of the current state of knowledge (as of 1977) concerning the population status, migration patterns, reproductive timing, and food habits of bowhead and beluga whales in the Bering, Chukchi and Beaufort Seas. The population of beluga whales in Bristol Bay is estimated at 1,000 to 1,500 resident animals.

ACCESS # : 042, IMS-UAF

CITATION : Burns, J.J., and K.J. Frost. 1979. The natural history and ecology of the bearded seal, *Erignathus barbatus*. ADF&G, Fairbanks. 77 pp.

KEY-WORDS: Bearded seal; Marine mammals; Ecology; Trophic dynamics.

SYNOPSIS : A comprehensive account of bearded seal population status, distribution, migration patterns, life history, productivity, mortality, and food requirements. Bristol Bay appears to be the southern limit of the species' winter range, with distribution and numbers dependent on ice conditions from one year to the next. Bearded seal food preferences are as described by Kosygin (1976).

ACCESS # : 043, IMS-UAF

CITATION : Cooney, R.T., C.P. McRoy, T. Nishiyama, and H.J. Niebauer. 1979. An example of possible weather influence on marine ecosystem processes. In: Alaska fisheries: 200 years and 200 miles of change. Proc. of the 29th Alaska Science Conference, B.R. Melteff (ed.). Ak. Science Conference, Fairbanks, Ak.

KEY-WORDS: Bering Sea; Ecosystems; Gadidae; Pisces; Weather.

SYNOPSIS : The notion that the timing of certain events is critical in mediating processes of organic matter synthesis and transfer in marine pelagic systems is explored with observations recently acquired from the southeast Bering Sea. A hypothesis is advanced relating the apparent survival of a major cohort of the 1977 year-class of walleye pollock (*Theragra chalcogramma*) to weather patterns monitored during the month of April, the time of egg incubation and hatching. An extrapolation of relative growth measures to the size at yolk-sac absorption predicts that first feeding larvae may have encountered an unusually favorable growth environment during the last week of that month, a period coincident with the only high pressure weather cell to move through the region. It is proposed that the temporarily stabilized wind mixed layer promoted the rapid growth or local concentration of microplankton required by the first-feeding larvae present at that time, and that these fishes enjoyed a significantly higher rate of survival than did larvae prior to or following this event. A generally unimodal distribution of sizes among the surviving post-larvae sampled later supports this notion.

ACCESS # : 044, IMS-UAF

CITATION : Cooney, R.T. and K.O. Coyle. 1982. Trophic implications of cross-shelf copepod distributions in the southeastern Bering Sea. Mar. Biol. 70: 187-196.

KEY-WORDS: Copepod; Distribution; Grazing; Oceanic fronts; Zooplankton; Trophic interactions.

SYNOPSIS : Spring distributions of some numerically dominant copepods reflect the two distinct water masses separated along the 80 to 100 m isobaths. Seaward of this middle shelf front, the oceanic Bering Sea hosts populations of *Calanus cristatus*, *C. plumchrus*, and *Eucalanus bungii bungii*; *Metridia pacifica*, *Oithona similis*, and *Pseudocalanus* spp. are also present. The large oceanic species are much less abundant in waters shallower than 80 m where the community is seasonably dominated by smaller copepods, *O. similis*, *Acartia longiremis*, and *Pseudocalanus* spp. Experiment- and field-derived estimates of carbon ingestion indicate that the oceanic/outer shelf copepods can occasionally graze the equivalent of the daily plant production and probably routinely remove 20-30% of the primary productivity. Conversely, stocks of middle shelf copepods rarely ingest more than 5% of the plant carbon productivity. During 45 d between mid to late May, 1979, approximately three-times more organic matter was ingested by the outer shelf/oceanic copepod community than by middle shelf species. This imbalance in cross-shelf grazing permits middle shelf phytoplankton stocks to grow rapidly to bloom proportions, and to sink ungrazed to the seabed. Over the outer shelf and particularly along the shelf break, a much closer coupling to phytoplankton supports a large biomass of oceanic grazers. Here, copepod stocks approaching 45 g dry wt m² occur in late spring as a narrow band at the shelf break.

ACCESS # : 045, ARL

CITATION : Cooney, R.T. 1978. Environmental assessment of the southeastern Bering Sea: zooplankton and microneckton. Principal Investigators' Reports for the Year Ending March 1978. Vol. 1. pp. 238-337. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Zooplankton; Microneckton; Copepods; Euphausiids; Walleye pollock.

SYNOPSIS : The distributional data obtained in this study, coupled with an understanding of the biology of the dominant species, is used to assess the relationship between the adjacent oceanic watermasses and that overlying the shelf and slope. Evidence is presented that suggests water shallower than 80 m is isolated biologically from the rest of the shelf environment. Recent physical oceanographic information is discussed as it relates to this observation. The results of this investigation complement the extensive work of Japanese and Soviet scientists by presenting data on the slope and shelf regimes. The influence of the seasonal ice pack is discussed and notions concerning the overall productivity of the region are developed.

ACCESS #: 046, IMS-UAF

CITATION : Cline, J.D., K. Kelly-Hansen and C.N. Katz. 1982. The production and dispersion of dissolved methane in southeastern Bering Sea. Contribution No. 558 from Pacific Marine Environmental Laboratory. NOAA/OMPA/OCSEAP final report. 98 pp.

KEY-WORDS: Methane; models; Current velocities; Port Moller; Salinity; Temperature.

SYNOPSIS : The goal of the study was to use methane as a tracer of mean circulation and to define vertical and horizontal mixing scales in local regions of the southeastern Bering Sea. Subregional studies concentrated on St. George Basin faultline and Port Moller. Methane generation lags carbon fixation by 3-4 months. The North Aleutian study occupied stations from the shore to beyond the 50 m front on several transects from east of Unimak Pass to east of Ugashik Bay in Aug. 1980, Feb. 1981, and May 1981. Evidence for fresh water input from Knik River and numerous small sources is evident even in February. Considerable detail of T, S, and density is given for the coastal zone region indicating a cyclonic circulation. Concentration of methane near the river front were 500 nl/l in August 1980 decreasing toward the northeast. Maximum concentrations were 22,000 nl/l found in Port Moller decreasing to 1200 nl/l at the entrance. Lower concentrations were found in February 1981 (300 nl/l) and May 1981 (100-200 nl/l). Mixing of methane, once it enters the coastal zone, is rapid in both the vertical and horizontal direction. The inner zone decreases systematically beyond the coastal zone seaward. The Csanady model was applied to the methane data to describe the dispersion of the plume originating in Port Moller.

ACCESS # : 047, RAS-UAF

CITATION : Codispoti, L.A., G.E. Frederick, R.L. Iverson, and D.W. Hood. 1982. Temporal changes in the Inorganic carbon system of the southeastern Bering Sea during spring 1980. Nature 296: 242-245.

KEY-WORDS: Total carbon dioxide; Partial pressure of CO₂(pCO₂); Primary production; Alkalinity; Dissolved oxygen; Chlorophyll a.

SYNOPSIS : Previous studies of the inorganic carbon system in southeastern Bering Sea demonstrated the occurrence of extremely low partial pressures of carbon dioxide (pCO₂) and depressed total carbon dioxide concentrations during late spring. To test the hypothesis that these conditions develop during the spring phytoplankton bloom, and to provide biological production data that would be independent of the carbon-14 technique, we monitored the inorganic system in this region intensively during spring 1980. We demonstrate here that there is a clear relationship between the changes in the inorganic carbon system and the spring phytoplankton bloom.

ACCESS # : 048, IMS-UAF

CITATION : Anon. 1970. Public Hearing, Izembek National Wildlife Range. Bureau of Sport Fisheries and Wildlife. 126 pp.

KEY-WORDS: Wildlife evaluation; Izembek Lagoon; Cold Bay; Zostera; Eelgrass; Waterfowl.

SYNOPSIS : This is a transcription of a review of the existing wildlife range and proposed changes. Public testimony is included from Anchorage and Cold Bay.

ACCESS # : 049, IMS-UAF

CITATION : Phillips, R.C., W.S. Grant and C.P. McRoy. 1983. Reproductive strategies of eelgrass (Zostera marina L.). Aquat. Bot. 16: 1-20.

KEY-WORDS: Zostera; Flowering; Germination; Pacific coast; Salinity; Temperature; Eelgrass.

SYNOPSIS : Zostera on the Pacific coast of North America exhibits a range of reproductive traits, from an entirely annual population in Baja to infrequently flowering plants in northern subtidal areas. A table is presented listing vegetative, reproductive shoots, seed number and spathes for the coastal United States. High salinities generally were shown to inhibit germination - with the exception of the Gulf of Mexico where temperature was important. Flowering increased at both extremes of geographic range. Intertidal, or tidally influenced plants flowered more frequently than plants from deep water. Theories pertaining to stress and disturbance derived for terrestrial plants are applied to Zostera.

ACCESS # : 050, IMS-UAF

CITATION : Phillips, R.C. 1976. Preliminary observations on transplanting and a phenological index of seagrasses. Aquat. Bot. 2: 93-101.

KEY-WORDS: Seagrasses; Alaska; Puget Sound; Transplanting; Survival; Izembek Lagoon; Eelgrass.

SYNOPSIS : Zostera was transplanted both across geographic and tidal lines. Plants transplanted within Puget Sound survived well. Morphological variations with respect to tidal zone were shown to be plastic. Plants transplanted from Izembek Lagoon to Puget Sound did not survive. Various methods were used and evaluated. Late winter and spring are the most successful periods for transplant.

ACCESS # : 051, NMFS

CITATION : Pereyra, W.T., J.E. Reeves, R.G. Bakkala. 1976. Demersal fish and shellfish resources of the eastern Bering Sea in the baseline year 1975. Northwest Fisheries Center Processed Report. National Marine Fisheries Service, NOAA, 619 pp + Data Appendices.

KEY-WORDS: Demersal fish; Shellfish; Commercially-important species; Fishery resources.

SYNOPSIS : This reports contains (1) findings from a multi-vessel demersal trawl survey of the fauna in the eastern Bering Sea (August-October, 1975); (2) a review of data from historical research vessel surveys and commercial catch statistics; and (3) a summarization of information from the literature pertaining to commercially-important species of demersal fish and shellfish. These studies were directed toward a description and assessment of the demersal fish and shellfish populations of the eastern Bering Sea with which the Bureau of Land Management can evaluate the real and potential impact of petroleum exploration and development. The results of these studies also provide a data base for assessment of stock conditions that will be used in the development policies for domestic and international fisheries, and in planning future research.

ACCESS # : 052, IMS-UAF

CITATION : Park, P.K., L.I. Gordon, and S. Alvarez-Borrego. The carbon dioxide system of the Bering Sea. In: Oceanography of the Bering Sea, D.W. Hood and E.J. Kelley (eds). OCC. Pub. No. 2. Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp. 107-147.

KEY-WORDS: Alkalinity; pH; Total carbon dioxide; Partial pressure of CO_2 ($p\text{CO}_2$); Carbonate minerals; Biochemical oxidation

SYNOPSIS : This paper reviews CO_2 data from all workers that have published on the Bering Sea including that of Alvarez-Borrego et al. 1971. (J. Oceanogr. Soc. Japan 28: 71-93) which has data on distribution of CO_2 system with depth at a line of stations across the southern Bering Sea. One station was taken in 200 fathoms of water west of Unimak Pass.

ACCESS # : 053, PMEL

CITATION : Fearson, C.A., E. Baker, and J.D. Schumacher. 1980. Hydrographic, suspended particulate matter, wind and current observations during re-establishment of a structural front: Bristol Bay, Alaska. Pacific Marine Environmental Laboratory/NOAA, Seattle. Preprint AGU 1980. 27 pp.

KEY-WORDS: Hydrography; Wind; Currents; Storm effects; Stratification; Ekman flux; Coastal domain.

SYNOPSIS : This paper is particularly valuable in showing the effect of storms on the conservative as well as non-conservative property distribution in the near shore areas of Bristol Bay.

ACCESS # : 054, RAS-UAF

CITATION : Petersen, M.R. 1980. Observations of wing-feathered molt and summer feeding ecology of Steller's Eiders at Nelson Lagoon, Alaska. Wildfowl. 31: 99-106.

KEY-WORDS: Eiders; Waterfowl; Feeding; Ecology; Trophic interactions; Molting.

SYNOPSIS : The author discusses the population size of Steller's Eiders in Nelson Lagoon, the molt chronology, feeding behavior and food habits throughout the summer.

ACCESS # : 055, RAS-UAF

CITATION : Petersen, M.R., and M.J. Sigman. 1977. Field studies at Cape Peirce, Alaska - 1976. Annual Reports of Principal Investigators. Vol. 4. pp. 633-693. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Seabirds; Cape Peirce; Waterfowl; Distribution; Breeding ecology.

SYNOPSIS : This report presents information on distribution, abundance, breeding biology, and predation of cliff-nesting marine birds in the Cape Peirce-Shaluk Island vicinity, with a discussion of the spring migration, molt, and foraging areas of loons and waterfowl in 1976. The two numerically dominant species are Common Murres, with a population of between 500,000 and a million, and Black-legged Kittiwakes, with a population between 200,000 and 400,000.

ACCESS # : 056, UW

CITATION : Poe, P.H., G.D. Cortner, and O.A. Mathison. 1976, Monitoring of the Kvichak spawning and nursery areas in 1975. ADF&G Final Rep. #2131

KEY-WORDS: Salmon; Kvichak Bay; Fisheries management.

SYNOPSIS : A description of previous research conducted on the Kvichak Bay salmon run, a presentation of data collected during the 1975 field season, and comparison of 1975 data with records from previous years is presented here. The data includes; 1) the distribution of escapement on the spawning beds, 2) the relative abundance, growth, and distribution of juvenile salmon, 3) rates of primary and secondary production, and 4) the thermodynamics and climatic conditions.

ACCESS # : 057, IMS-UAF

CITATION : VTN Oregon. 1983d. Ecological characterization of shallow subtidal habitats in the northern Aleutian Shelf. Personal communication with Dr. Robert Cimberg of VTN Oregon to Stephen Pace of Kinnetic Laboratories, inc., September 1983. RE: Food of sea otters.

KEY-WORDS: Trophic interactions; Sea otter; Food; Prey items; Marine mammals.

SYNOPSIS : Although the report from this project is not yet available, information of sea otter food, based on scat examination revealed that four identifiable prey items were taken by sea otters. These items were razor clams, king crab, yellowfin sole, and flathead sole. Importance and/or quantities of these items are not yet available.

ACCESS # : 058, IMS-UAF

CITATION : Schandelmeier, L., and V. Alexander. 1981. An analysis of the influence of ice on spring phytoplankton population in the southeast Bering Sea. Limnol. Oceanogr. 26(5): 935-943.

KEY-WORDS: Phytoplankton; Population structure; Ice; Algal blooms; Bering Sea.

SYNOPSIS : Phytoplankton populations in the southeast Bering Sea were examined with respect to the influence of ice on population structure. Techniques of numerical analysis were applied to the data collected from 109 stations over a 3-year period. Two major groups were present in spring ice-edge groups and a shelf-break group. Results suggest that the ice-edge spring bloom is a distinct but short-lived community, and that ice flora may act as an inoculum early in the spring bloom.

ACCESS #: 059, IMS-UAF

CITATION : Goering, J.J., and C.P. McRoy. 1981. A synopsis of PROBES. Eos Trans. Am. Geophys. Union. 62(44): 730-731.

KEY-WORDS: Research programs; Ecosystems; Productivity; Oceanic fronts; Trophic Interactions; Food web.

SYNOPSIS : PROBES is a multi-institutional, interdisciplinary study of the marine ecosystem of the southeastern Bering Sea. The major effort of the program is to understand the processes that contribute to the large production of animals in various trophic levels. The waters over this shelf are highly structured and consist of discrete domains divided by three distinct oceanic fronts. PROBES is examining the importance of these fronts in regulating production of plants and animals and has discovered that these fronts are zones of enhanced biological activity and that the patterns of phytoplankton and zooplankton growth, biomass, and species composition are organized in relation to the fronts. The middle front, in particular, is a zone of enhanced biological activity, and it separates the middle shelf benthic dominated food web region from the outer shelf pelagic food web dominated region.

ACCESS # : 060, IMS-UAF

CITATION : Niebauer, H.J., C.P. McRoy, J.J. Goering, and R. Iverson. 1982. Productivity data: R/V T.G. Thompson Cruises TT131, TT138, TT149 and TT159. PROBES: Processes and Resources of the Bering Sea Shelf. Unpubl. Data Rept. #82-009. Inst. Mar. Sci., Univ. Ak., Fairbanks. 225 pp.

KEY-WORDS: Primary production; Nutrients; Hydrography.

SYNOPSIS : This report contains all PROBES primary productivity and ancillary data from the Bering Sea shelf. There were a total of 4 carbon or nitrogen productivity stations taken in 1978 and 1979 in the waters close to the north side of the Alaska Peninsula, most in the vicinity of Unimak Island. No stations were actually taken within the 5 km nearshore zone. During late April and early May primary productivity was about $2 \text{ gCm}^{-2}\text{d}^{-1}$. These rates are typical of the spring bloom in the middle and outer shelf of this region but they are not necessarily applicable to the 5 km zone.

ACCESS # : 061, IMS-UAF

CITATION : McBride, D.N., J.H. Clark and L.S. Buklis. 1982. Assessment of intertidal aquatic plant abundance in the Togiak area of Bristol Bay, Alaska, 1978 through 1979 with emphasis on *Fucus* sp. ADF&G Data Rept. No. 74. 16 pp.

KEY-WORDS: Seaweeds; *Fucus*; Herring.

SYNOPSIS : This report includes quantitative assessments of seaweed abundance on the northern shore of inner Bristol Bay. In this area seaweed is a substrate for herring spawn and it is the basis of a commercial harvest.

ACCESS # : 062, IMS-UAF

CITATION : Iverson, R.L., L.K. Coachman, R.T. Cooney, T.S. English, J.J. Goering, G.L. Hunt, Jr., M.C. Maccauley, C.P. McRoy, W.S. Reeburgh and T.E. Whitledge. 1979. Ecological significance of fronts in the southeastern Bering Sea. Pgs. 437-466 in: R.J. Livingston (ed.), Ecological Processes in Coastal and Marine Systems. Plenum Publ. Corp., NY.

KEY-WORDS: Plankton; Productivity; Oceanography; Nutrients; Ecology; Fishes; Benthos.

SYNOPSIS : Three fronts; inner, middle, and outer, divide the continental shelf of the southeastern Bering Sea into three interfrontal zones which contain different food webs. The outer shelf zone contains primarily a pelagic food web while the middle and inner shelf have a predominantly benthic food web.

ACCESS # : 063, IMS-UAF

CITATION : Hood, D.W. 1983. The Bering Sea. Pgs. 337-373 in: B.H. Ketchum, ed., Estuaries and Enclosed Seas. Elsevier Sci. Publ. Co., Amsterdam.

KEY-WORDS: Bering Sea; Oceanography; Chemistry; Biology.

SYNOPSIS : This paper is a general overview of the oceanography, chemistry, and biology of the Bering Sea.

ACCESS # : 064, IMS-UAF

CITATION : VTN Oregon. 1983b. Cruise Report: Cruise 21833 (RP-MF-83A. Leg III), 2-17 June 1983, OCSEAP Red King Crab Distribution. VTN Oregon, Inc. Wilsonville, OR. 5 pp.

KEY-WORDS: King crab; Distribution; Juveniles; Larvae.

SYNOPSIS : Stations in Bristol Bay were sampled for water column parameters, zooplankton and epibenthic invertebrates. Observed densities of larval red king crab were low throughout the study area, with an apparent concentration in north-central Bristol Bay over deep water. The smallest Juvenile red king crabs (<10 mm) were collected primarily in Port Moller-Port Heiden area at moderate depths; larger Juveniles (10-60 mm) were collected primarily in the northeast end of Bristol Bay, especially Kvichak Bay. The majority of adult crabs collected, including bearing females, were from deeper waters of northern Bristol Bay. Water column chemical/physical data and epibenthic fauna data were recorded for each station.

ACCESS # : 065, NMFS

CITATION : Sears H.S. and S.T. Zimmerman. 1977. Alaska Intertidal survey atlas. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Auke Bay Laboratory, P.O. Box 155, Auke Bay, Ak.

KEY-WORDS: intertidal habitats; Aerial survey; Stratum composition; Beach slope; Biological cover.

SYNOPSIS : Aerial observations were made primarily to classify and provide information on three general littoral parameters: stratum composition, beach slope, and biological cover. Most observations were made from an amphibious aircraft flown at an elevation of approximately 200 ft. Four hundred and two plates were used to describe the coastline from Yakutat to Cape Prince of Wales. In order to facilitate regional usage, the plates were divided into eight geographical areas. The plates present data in the form of: five categories of strata; four categories of biological cover; four categories of beach slope; and other biological phenomena which are divided into categories for wildlife or vegetation.

ACCESS # : 066, OCSEAP/NOAA

CITATION : Michel, J., D.D. Domeracki, L.C. Thebeau, C.D. Getter, and M.O. Hayes. 1982. Sensitivity of coastal environments and wildlife to spilled oil of the Bristol Bay area of the Bering Sea, Alaska. Research Planning Institute, Inc. RPI/R/82/1/15-1, 117 pp + 106 maps. Prepared for NOAA, OCSEAP, Juneau, Ak.

KEY-WORDS: Oil spill; Coastal habitats.

SYNOPSIS : This report is an explanatory text for a series of maps delineating the sensitivity of coastal environments of Bristol Bay, Alaska, to oil spill impact. The study area extended from Unimak Island to Cape Vancouver, including Nunivak Island. The classification used, the Environmental Sensitivity Index (ESI), ranks coastal environments on a scale of 1 to 10 in order of increasing sensitivity 1 to oil (i.e., 1 is least sensitive and 10 is most sensitive). Oil-sensitive wildlife and fisheries, such as the location of bird colonies, seal haulouts, and shellfish areas, are also indicated on the maps. Field surveys were conducted between 24 July and 28 August, 1981. A shoreline assessment technique, called the integrated zonal method, was used to describe and classify the coastal environments of Bristol Bay. The technique included aerial reconnaissance of the entire shoreline, detailed ground studies and sampling at 36 profile stations, 16 rapid-survey sites, and an extensive review of available literature. The physical and biological components of each ESI shoreline type is described, along with the predicted oil behavior and damage, and habitats are discussed in terms of the major species present, their distribution, the effect of oil, and recommended response measures. Areas of socioeconomic importance are also indicated on the maps and discussed in the text. Finally, general protection strategies are proposed for different regions.

ACCESS # : 067, Shell Oil Company, Houston, TX.

CITATION : Gusey, W.F. 1979. The fish and wildlife resources of the southeastern Bering Sea region. Environmental Affairs, Shell Oil Company, Houston, TX. 370 pp.

KEY-WORDS: Fisheries; Distribution; Crab; Shrimp; Fishes; Crustacea.

SYNOPSIS : This publication describes the more conspicuous, esthetically important and commercially valuable fish and wildlife resources of the southern Bering Sea region -- those species that permanently or seasonally occupy the waters over the Bering Sea Continental Shelf from the Aleutian Islands to the Pribilof Islands, and eastward to the Alaska mainland. Little data are available that pertains to the nearshore zone (<50m) of the north Aleutian Basin.

ACCESS # : 068, IMS-UAF

CITATION : Sarvis, J. 1982. Annual narrative report: Izembek National Wildlife Refuge. Unpubl. Rept., U.S. Dept. Interior, Natl. Wildl. Refuge System, Fish Wildl. Service. 137 pp.

KEY-WORDS: Izembek Lagoon, Waterfowl; Marine mammals; Fish.

SYNOPSIS : This report covers observations and activities on Izembek and associated refuges for 1982. A summary of monthly weather data at Cold Bay is included. The report contains a summary of Whistling Swan surveys in the region and includes some production data. The continuing counts of Brant production show 9.5% juveniles for the year and 24.4% for the average for 1963-82; family composition data and mid-winter population data are also given. The report contains a table summarizing productivity and family composition data for Emperor Geese; the average for 1966-82 is 27% juveniles, while for 1982 it was 7.8%. A map presents population data for Emperor Geese on the coast of the Peninsula and Bristol Bay for late April. The winter bird list is also included. Another figure shows the distribution and abundance throughout the year of Steller's Eiders in Izembek Lagoon. From an aerial survey the refuge personnel counted 2208 sea otters and 1971 harbor seals in Izembek Lagoon. A former estimate from 1975 indicated 4500 to 5000 harbor seals in the lagoon. Four walrus were seen at Pt. Divide and in Port Moller.

ACCESS # : 069, IMS-UAF

CITAT/Old : Sarvis, J. 1981. Annual narrative report: Izembek National wildlife Refuge. Unpubl. Rept., U.S. Dept. Interior, Natl. Wildl. Refuge System, Fish Wildl. Service. 119 pp.

KEY-WORDS: Izembek Lagoon; Waterfowl; Marine mammals; Fish; Unimak Island.

SYNOPSIS : This report covers observations and activities on Izembek and associated refuges for 1981. A summary of monthly weather data at Cold Bay is included. The report contains a summary of Whistling Swan surveys in the region and includes some production data. The continuing counts of brant production show 18.6% juveniles for the year and 25.2% for the average for 1963-81; family composition data and mid-winter population data are also given. The report contains a table summarizing productivity and family composition data for Emperor Geese; the average for 1966-81 is 28.4% juveniles, while for 1981 it was 31.7%. A map presents population data for Emperor Geese on the coast of the Peninsula and Bristol Bay for late April. The winter bird list is also included. Two surveys of beached marine mammals were conducted resulting in 26 sea otter, 2 sea lion and 2 walrus carcasses. A group of 250 walrus were seen in their usual haunts near Cape Seniavin, 110 miles NE of Izembek. A table of salmon catch and escapement for the area streams is included. On Unimak Island, NOAA observers counted 14,346 gray whales (including 167 calves) and 26 killer whales over 87 days.

ACCESS # : 070, IMS-UAF

CITATION : Sarvis, J. 1980. Annual narrative report: Izembek National Wildlife Refuge. Unpubl. Rept., U.S. Dept. Interior, Natl. Wildl. Refuge System, Fish Wildl. Service.

KEY-WORDS: Izembek Lagoon; Waterfowl; Weather; Marine mammals; Fish; Unimak Island.

SYNOPSIS : This report covers observations and activities on Izembek and associated refuges for 1980. A summary of monthly weather data at Cold Bay is included. The report contains a summary of Whistling Swan surveys in the region and includes some production data. The continuing counts of Brant production show 25.8% juveniles for the year and 25.5% for the average for 1963-80; family composition data are also given. The report contains a table summarizing productivity and family composition data for Emperor Geese; the average for 1966-80 is 28.2% Juveniles. Another table gives the results for aerial surveys in Izembek Lagoon for fall 1980 and spring 1981. A winter bird list for the Cold Bay region is also included. A beaked whale carcass was found on a Bering Sea beach and a herd of about 1000 walrus was seen NE of Izembek. The report again has data on salmon catch and escapement. Data collected from Unimak Island include beached mammal and bird surveys, estimates of murre passing Cape Sarichef and complete bird list for the cape area. A beaked whale carcass was again found on the island.

ACCESS # : 071, IMS-UAF

CITATION : Sarvis, J. 1979. Annual narrative report: Izembek National Wildlife Range. Unpubl. Rept., U.S. Dept. Interior, Natl. Wildl. Refuge System, Fish Wildl. Service. 67 pp.

KEY-WORDS: Izembek Lagoon; Waterfowl; Marine mammals; Fish; Unimak Island; Amak Island.

SYNOPSIS : This report is a summary of natural history observations in the Izembek and Unimak Island region by refuge personnel. A brief summary of weather averages and extremes for the year is included. Data tables show the % of Juvenile Brant for 1971-79 and the family group composition for 1966-79. Refuge personnel considered the numbers of gray whale, sea otter and harbor seal carcasses on Bering Sea beaches to be usual but they report a large increase (about 100 vs. 2 in 1978) in the numbers of headless walrus and attribute this to native subsistence hunting. A transient herd of about 500 hauled out on Amak prior to the appearance of the corpses. Another beaked whale was also found. The report includes tables showing catch and escapement of all salmon species in the streams of Cold Bay, Morzhovoi Bay, Izembek Lagoon and Moffett Lagoon for 1969-79. A winter bird list for Unimak Island is included.

ACCESS # : 072, IMS-UAF

CITATION : Sarvis, J. 1978. Annual narrative report: Izembek National Wildlife Range. Unpubl. Rept., U.S. Dept. Interior, Natl. Wildl. Refuge System, Fish Wildl. Service. 55 pp.

KEY-WORDS: Izembek Lagoon; Waterfowl; Weather; Marine mammals; Fish.

SYNOPSIS : This report is a summary of natural history observations in the Izembek and Unimak island region by refuge personnel. A brief summary of weather averages and extremes for the year is included. Data tables show the % of juvenile Brant for 1971-78 and the family group composition for 1966-78. The range of mean family size is 2.28 to 3.22. A list of winter birds is included. A summary of sightings of marine mammal carcasses on the Bering Sea beaches includes: 2 sea otters, 2 walrus, 1 sea lion, 2 gray whales and 1 beaked whale (Mesoplodon stejnegeri).

ACCESS # : 073, IMS-UAF

CITATION : Sarvis, J. 1977. Annual narrative report: Izembek National Wildlife Range. U.S. Dept. Interior, Natl. Wildl. Refuge System, Fish Wildl. Service.

KEY-WORDS: Izembek Lagoon; Waterfowl; Marine mammals; Amak Island; Unimak Island.

SYNOPSIS : The report contains a record of birds banded around Izembek Lagoon for 1970 through 1977 and natural history observations on waterfowl and wildlife in the region. A summary of \$ juveniles of the Brant population is given for 1971 through 1977; in all years the % young averaged 30 to 38 with the exception of 1974 when it was only 5. Detail of population structure is also given for 1966 through 1977 and a table of total population estimates of Brant on the Pacific coast is presented for 1964 through 1978. The 24 year (54-77) average population is 140,888. Population data for the Emperor Goose for 1974-77 are also given. The author reports observations from aerial surveys of gray whale movements on the north side of Unimak Island and the Peninsula. Counts of seabirds present on Amak Island and Sea Lion Rock are given along with an estimate of the Steller's Sea Lion population on the islands (Amak=2000; Sea Lion Rock=3000).

ACCESS # : 074, IMS-UAF

CITATION : McRoy, C.P., J.J. Goering and W.E. Shiels. 1972. Studies of primary production in the Eastern Bering Sea. Pp. 199-216 In: A.Y. Takenouti, ed. Biological Oceanography of the Northern North Pacific Ocean. Idemitsu Shoten, Tokyo.

KEY-WORDS: Primary production; Unimak Pass; Izembek Lagoon.

SYNOPSIS : Data are presented for phytoplankton productivity and biomass (chlorophyll a) in the surface waters of Izembek Lagoon and Unimak Pass. Daily rates from 30 Jun to 1 Aug 68 averaged $78.7 \text{ mgC/m}^3\text{-day}$ with a biomass of $1.24 \text{ mg chlora/m}^3$. In Unimak Pass productivity averaged $243 \text{ mgC/m}^3\text{-day}$ and biomass was $76.0 \text{ mg chlora/m}^3$. All measurements were in June in 1968 and 1970. Nitrate and ammonia uptake were also measured at one station in Unimak Pass; the ratio of carbon uptake to nitrogen uptake at this station was 6.7.

ACCESS # : 075, IMS-UAF

CITATION : McRoy, C.P. and J.J. Goering. 1976. Annual budget of primary production in the Bering Sea. Mar. Sci. Comm. 2(5): 255-267.

KEY-WORDS: Primary production; Rivers; Lagoons.

SYNOPSIS : The authors construct an annual budget of primary production for the Bering Sea. The primary production of the shelf is estimated to be 141,000,000 m.t. carbon/yr which is 51% of the estimated total production. Rivers contribute 1 to 6,000,000 m.t. carbon, 75% of which is from the Alaska coast. The lagoons of the Alaska Peninsula contribute an estimated 105 m.t. carbon/yr as eelgrass detritus.

ACCESS # : 076, IMS-UAF

CITATION : McRoy, C.P. and J.J. Goering. 1974. The Influence of ice on the primary productivity of the Bering Sea. in: D.W. Hood and E.J. Kelley (eds.), Oceanography of the Bering Sea. Occ. Pub. No. 2, Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp. 403-421.

KEY-WORDS: Primary production; Unimak Pass; Hydrography.

SYNOPSIS : This paper reports phytoplankton productivity, biomass (chlorophyll a), temperature and salinity on a transect from Unimak Pass to the ice edge in April, 1971. Surface chlorophyll a was less than 1 mg/m³.

ACCESS # : 077, IMS-UAF

CITATION : McRoy, C.P. and C. McMillan. 1977. Production ecology and physiology of seagrasses. Pp. 53-87 in: C.P. McRoy and C. Helfferich, eds. Seagrass Ecosystems. Marcel Dekker, Inc. New York.

KEY-WORDS: Primary production; Seagrasses; Nutrient cycling; Culture methods; Eelgrass.

SYNOPSIS : This paper presents comparisons of productivity and biomass for temperate and tropical seagrasses. A nitrogen budget for eelgrass in Izembek Lagoon is included.

ACCESS # : 078, IMS-UAF

CITATION : McRoy, C.P. 1977, Seagrass ecosystem studies at Izembek Lagoon: Report of field activities for 1977. Unpubl. Rept., Inst. Mar. Sci., Univ. Alaska, Fairbanks. 33 pp.

KEY-WORDS: Izembek Lagoon; Food-web; Invertebrates; Fish; Nutrient cycling; Phenology; Eelgrass.

SYNOPSIS : This is a progress report of research studies of the eelgrass communities of Izembek Lagoon. A quantitative description of the plant community is included along with some data on sediment nitrogen concentrations. A phenological index comparing eelgrass in Izembek Lagoon to other locations in North America is presented. A species list of invertebrates and fishes occurring in the lagoon is also presented along with a diagram of food web relationships.

ACCESS # : 079, IMS-UAF

CITATION : McConnaughey, T. and C.P. McRoy. 1979. Food web structure and the fractionation of carbon isotopes in the Bering Sea. Mar. Biol. 53: 257-262.

KEY-WORDS: Carbon isotopes; Food web; Plankton; Benthos.

SYNOPSIS : ^{13}C undergoes modest biomagnification in the food web, apparently as a result of being respired at a slower rate than ^{12}C . Using carbon isotope ratio data from pelagic and benthic invertebrates, and fishes, birds, and mammals from the Bering Sea, a model was constructed suggesting that the food web contains 5 or 6 trophic levels. The pelagic system includes about 3 and the benthos 5. Most phytoplankton carbon passes through zooplankton before reaching other consumers. Most carbon remains in the pelagic system and does not reach the benthos. Few benthic filter-feeders rely entirely on phytoplankton for food. Detritus entering the benthic system passes through 1 or 2 trophic steps before reaching the macrofauna. Predatory benthic fishes rely less on benthic macrofauna for food than on pelagic animals.

ACCESS # : 080, IMS-UAF

CITATION : Jones, R.D., Jr. 1971. Refuge narrative report: Aleutian islands National Wildlife Refuge, Simeonof NWR, Semidi NWR, Bogoslof NWR and Izembek National Wildlife Range. Unpubl. Rept., U.S. Dept. Interior, Bur. Sport Fish. Wildl., Fish Wildl. Serv., Cold Bay, Ak. 28 pp.

KEY-WORDS: Aleutian Islands; Izembek Lagoon; Wildlife; Waterfowl; Nelson Lagoon.

SYNOPSIS : This report contains average precipitation, temperature and wind data for Cold Bay, Adak and Shemya for 1971. Notes on waterfowl in the area are included. Data are given for family group counts for Black Brant in Izembek Lagoon. There are also data for the % juveniles in Emperor Goose families at several locations on the Peninsula. A table is included of the commercial catch and escapement for 1963 through 1971 of the five salmon species that spawn in streams in Izembek Lagoon and Moffett Bay. The author conducted an aerial survey of Nelson Lagoon in late August and includes a list of waterfowl observed with population estimates of some species.

ACCESS #: 081, IMS-UAF

CITATION : Jones, R.D., Jr. 1967. Refuge narrative report: Aleutian Islands National Wildlife Refuge and Izembek National Wildlife Range. Unpubl. Rept., U.S. Dept. Interior, Bur. Sport Fish. Wildl., Fish Wildl. Serv., Cold Bay, Ak. 44 pp.

KEY-WORDS: Izembek Lagoon; Waterfowl; Weather; Eelgrass; Wildlife.

SYNOPSIS : The report is a narrative of natural history observations at izembek and in the western Aleutian Islands. Average monthly weather data are included for Cold Bay, Adak and Shemya. An analysis of the population structure of Brant in Izembek is presented.

ACCESS # : 082, IMS-UAF

CITATION : Jones, R.D., Jr. 1966. Refuge narrative report: Aleutian islands National Wildlife Refuge and Izembek National Wildlife Range. Unpubl. Rept., U.S. Dept. Interior, Bur. Sport Fish. Wildl., Fish Wildl. Serv., Cold Bay, Ak. 37 pp.

KEY-WORDS: izembek Lagoon; Waterfowl; Weather; Eelgrass; Wildlife.

SYNOPSIS : The report is a narrative of natural history observations at izembek and in the western Aleutian Islands. Average monthly weather data are included for Cold Bay, Adak and Shemya. An analysis of the population structure of Brant in Izembek is presented.

ACCESS # : 083, IMS-UAF

CITATION : Jones, R.D., Jr. 1965. Refuge narrative report: Aleutian Islands National Wildlife Refuge and Izembek National Wildlife Range. Unpubl. Rept., U.S. Dept. Interior, Bur. Sport Fish. Wildl., Fish Wildl. Serv., Cold Bay, Ak. 44 pp.

KEY-WORDS: Izembek Lagoon; Waterfowl; Weather; Eelgrass; Wildlife.

SYNOPSIS : The report contains the monthly weather data summaries for Cold Bay and Adak. The author presents his annual natural history observations on the wildlife and waterfowl. Brant population structure data are included.

ACCESS # : 084, IMS-UAF

CITATION : Jones, R.D., Jr. 1964. Refuge narrative report: Aleutian Islands National Wildlife Refuge and Izembek National Wildlife Range. Unpubl. Rept., U.S. Dept. Interior, Bur. Sport Fish. Wildl., Fish Wildl. Serv., Cold Bay, Ak. 54 pp.

KEY-WORDS: Izembek Lagoon; Waterfowl; Weather; Eelgrass; Fish; Wildlife.

SYNOPSIS : The narrative report includes the averages of standard weather data for each month at Cold Bay and Adak. Natural history notes on wildlife and waterfowl are included. Presents additional counts of the Brant population in Izembek. A list of 26 fish species caught in Izembek is included.

ACCESS #: 085, IMS-UAF

CITATION : Jones, R.D., Jr. 1963. Refuge narrative report: Aleutian Islands National Wildlife Refuge and Izembek National Wildlife Range. Unpubl. Rept., U.S. Dept. Interior, Bur. Sport Fish. Wildl., Fish Wildl. Serv., Cold Bay, Ak. 21 pp.

KEY-WORDS: Izembek Lagoon; Waterfowl; Weather; Eelgrass; Wildlife.

SYNOPSIS : This is essentially a narrative of natural history observations and activities on the Izembek Range for September through December. Some weather data for the period is included. Family counts of Black Brant to determine % juveniles were begun this year. Biomass data are given for few waterfowl species collected by hunters. The report includes a figure showing the chlorophyll a content of eelgrass leaves.

45

ACCESS # : 086, IMS-UAF

CITATION : Williams, S.L. and C.P. McRoy. 1982. Seagrass productivity: the effects of light on carbon uptake. Aquat. Bot. 12: 321-344.

KEY-WORDS: Seagrasses; Geographic variation; Productivity; Light; Eelgrass; Carbon uptake; Population ecology.

SYNOPSIS : ¹⁴C uptake is used to document the effects of light levels on six genera of North American seagrasses. Productivity increased on a north-south gradient. Where species co-occur ecological status determines response to light stress. Two different responses are predicted for the different forms (tidal and subtidal) of *Zostera* in Izembek Lagoon.

ACCESS # : 087, IMS-UAF

CITATION : Smith, R. and A.C. Paulson. 1978. Izembek Lagoon. Sea Frontiers. 24: 30-38.

KEY-WORDS: Izembek Lagoon; History; Habitat; Wildlife; Eelgrass; Waterfowl.

SYNOPSIS : This article is a general survey of the Izembek Wildlife Range environment. The history of the area is briefly presented. Izembek is a critical habitat for marine birds. The seagrass beds of the lagoon are thought to be the basis of the high productivity of the area.

ACCESS # : 088, IMS-UAF

CITATION : Short, F.T. 1983. The response of interstitial ammonia in eelgrass (*Zostera marina* L.) beds to environmental perturbations. J. Exp. Mar. Biol. Ecol. 68: 195-208.

KEY-WORDS: Zostera; Izembek Lagoon; Perturbation; Nutrients; Eelgrass; Sediments.

SYNOPSIS : Ammonia pools are related to observed biomass of Zostera. Colonization of eelgrass is documented after ice scour on natural and introduced substrata. Ammonia levels decrease as colonization precedes. Ammonia-nitrogen is postulated to be limiting in shallow environments and possibly during the height of the growing season at high organic (deep water) stations. Sediments are capped and leaves clipped to elucidate nitrogen turnover and uptake.

ACCESS # : 089, IMS-UAF

CITATION : Short, F.T. 1981. Nitrogen resource analysis and modeling of an eel grass (*Zostera marina* L.) meadow in Izembek Lagoon, Alaska. Ph.D. Dissertation. Univ. of Alaska. 173 pp.

KEY-WORDS: *Zostera*; Izembek Lagoon; Nitrogen uptake; Sediments; Perturbation; Models; Eelgrass; Nutrients.

SYNOPSIS : This study attempts to correlate sediment nitrogen concentrations with observed plant biomass. Uptake experiments using ¹⁵N demonstrate the importance of the water column and leaf uptake as well as root uptake. High values of sediment nitrogen were found in beds with high plant biomass. Perturbation experiments examined the effects of ice scouring and subsequent recolonization. Nitrogen levels were monitored in natural and introduced substrata. Leaves were removed and sediments in two experiments designed to document ammonia turnover and uptake rates. A computer model was developed to predict biomass, leaf length and effects of fertilization.

ACCESS # : 090, IMS-UAF

CITATION : Reardon, J. 1975. Izembek spells tops in waterfowling. *Outdoor Life*. 155(5): 78-81, 141-142, 145.

KEY-WORDS: Izembek Lagoon; Geese; Hunting; Eelgrass.

SYNOPSIS : An account of goose hunting at Izembek. Some information on goose population and conditions for migration south.

ACCESS # : 091, IMS-UAF

CITATION : Merritt, L.B.C.P. McRoy. 1972. Simulation of the annual ecological cycle of shallow marine plants - Eelgrass of Izembek Lagoon, Alaska. Unpublished manuscript. Int. Sympos. Math. Model. Tech. in Water Resources Systems. 13 pp.

KEY-WORDS: Zostera; Models; Izembek Lagoon; Eelgrass; Productivity.

SYNOPSIS : Description of a mathematical model that depicts biomass changes in Izembek Lagoon of Zostera. The model is based upon data from 1967, and generates an hourly growth rate. Biomass and physical parameters may be adjusted to test effects on the ecosystem. Light was shown to be an important variable; assumptions made in the model include a homogeneous grass bed and a non-limiting nutrient supply. Simulations showed measured rates of photosynthesis to be too low to account for observed growth.

ACCESS # : 092, IMS-UAF

CITATION : McRoy, C.P. and S.L. Williams. 1977. Sublethal effects on seagrass photosynthesis. OCSEAP/NOAA. Final report. 36 pp.

KEY-WORDS: Seagrasses; Photosynthesis; Hydrocarbons; Light requirements; Izembek Lagoon; Eelgrass.

SYNOPSIS : This report contains a review of seagrass ecosystem biology. The importance of viewing eelgrass meadows as ecosystems in light of potential perturbation is stressed. Light requirements were investigated for three genera from Alaska (Zostera - Izembek Lagoon, Rupia - Izembek Lagoon, Phyllospadix - southeastern). A ¹⁴C technique was developed for work on seagrasses. The effects of toluene and kerosene were assessed in the laboratory and in situ. Kerosene depressed plant growth but toluene had no effect. Electron microscopy showed plant cell deformation after exposure to hydrocarbons.

ACCESS #: 093, RAS-UAF

CITATION : McRoy, C.P. and N. McRoy. 1965. Field observations on the summer birds of the Izembek Lagoon region of the Alaska Peninsula. Bull. Alaska Ornithol. Soc. 5: 1-7.

KEY-WORDS: Birds; Izembek Lagoon; Waterfowl.

SYNOPSIS : This report is an annotated list of 54 birds observed around Izembek Lagoon during the summer of 1964.

ACCESS # : 094, IMS-UAF

CITATION : McRoy, C.P., D.C. Burrell, J. Goering and R.J. Barsdate. 1974. Heavy metal dynamics in seagrass ecosystems: processes and oceanic interactions. Unpublished Report. NSF/DOE Pollutant Transfer Meeting. 20 pp.

KEY-WORDS: Trace metals; Cycling; Zostera; Izembek Lagoon; Eelgrass.

SYNOPSIS : Trace metal cycling is complicated by plant interactions with the sediments and food chain transfers. This report *presents* objectives for study of uptake of Zn, Cu, Cd, Hg, As, and Si. Preliminary results indicate that roots are enriched in Zn and Cu, but depleted in Cd with respect to leaves. A table with trace metal concentrations of various plant parts is included.

ACCESS # : 095, IMS-UAF

CITATION : McRoy, C.P., R.J. Barsdate and M. Nebert. 1972. Phosphorus cycling in an eelgrass (Zostera marina L.) ecosystem. Limnol. and Oceanography. 17(1): 58-67.

KEY-WORDS: Zostera; Izembek Lagoon; Phosphorus uptake; Nutrients; Eelgrass.

SYNOPSIS : Zostera is postulated as mechanism for transfer of phosphorus from sediments to water column. Phosphorus requirements and transfer rates are calculated and a box model is created. Resupply of phosphorus to the lagoon is suspected to occur through remineralization of detritus and mobilization from volcanic sands.

ACCESS # : 096, IMS-UAF

CITATION : McRoy, C.P. and R.J. Barsdate. 1970. Phosphate absorption in eelgrass. Limnol. and Oceanography. 15: 6-13.

KEY-WORDS: Phosphorus uptake; Zostera; Izembek Lagoon; Nutrients; Eelgrass.

SYNOPSIS : Plants were separated into roots, rhizomes, and various leaf parts and exposed to ^{32}P tracer. incubations were performed in the light and dark in an effort to document the role of light in uptake. $^{32}\text{PO}_4$ was also injected directly into sediments in the lagoon to measure in situ. Phosphate uptake increased with increasing light and was demonstrated to appear in the leaf tissue within 24 hours in the lagoon experiments. Significant transfer was shown from roots into the water column but the reverse was not observable.

ACCESS # : 097, IMS-UAF

CITATION : McRoy, C.P. 1974. Seagrass productivity: Carbon uptake experiments in eelgrass, *Zostera marina*. *Aquiculture*. 4: 131-137.

KEY-WORDS: *Zostera*; Izembek Lagoon; Carbon; Productivity; Eelgrass.

SYNOPSIS : ^{14}C was used to correlate light intensity with primary productivity in Izembek Lagoon. Five light levels were tested using various filters. Water, temperature, and solar radiation were recorded. Productivity in eelgrass is complicated by an unknown degree of internal recycling of gases and loss of organics. A relationship between light and productivity was derived, kinetic constants were variable. Inhibition was seen at high light intensities. Leaf turnover was estimated at twice per year.

ACCESS # : 098, IMS-UAF

CITATION : McRoy, C.P. 1974. Seagrass ecosystems of the Pacific coast of North America. Unpublished manuscript. AAAS Meetings. San Francisco, Calif. 5 p.

KEY-WORDS: Seagrasses; Eelgrass; Izembek Lagoon; Decomposition; Human use.

SYNOPSIS : This paper presents a review of seagrass distribution along the Pacific coast. Izembek Lagoon is discussed and detrital loss estimated at 500,000 metric tons dry weight each year. Microbial decomposers are an important food source to eelgrass detritus grazers; direct grazing is limited. Seri Indians were reported to use eelgrass seeds as a food source.

ACCESS #: 099, IMS-UAF

CITATION : McRoy, C.P. 1970. Standing stocks and other features of eelgrass (*Zostera marina*) populations on the coast of Alaska. J. Fish. Res. Bd. Can. 27: 1811-1821.

KEY-WORDS: Zostera; Standing stock; Benthic algae; Coastal Alaska; Eelgrass; Izembek Lagoon.

-SYNOPSIS : This study compares eelgrass beds in ten sites on the Alaskan coast from southeastern to the Seward Peninsula. Standing stocks and densities were highest at Izembek and Kinzarof Lagoons on the Alaska Peninsula. Differences were attributed to local environmental conditions and not latitude. Occurrence of benthic algae was correlated with sediment type. Caloric value and chlorophyll concentrations are reported for all sites.

ACCESS # : 100, IMS-UAF

CITATION : McRoy, C.P. 1970. On the biology of eelgrass in Alaska. Ph.D. Dissertation. Univ. Alaska. 156 pp.

KEY-WORDS: Izembek Lagoon; Coastal Alaska; Productivity; Elemental composition; Zostera; Eelgrass.

SYNOPSIS : Review of eelgrass biology. The chemical composition of Zostera is presented in tabular form. Because eelgrass is a rooted plant it is important in recycling nutrients that would otherwise likely be lost to the sediments. Protein content, lipids, ash, carbohydrate, and vitamin composition is reported. These values are compared with several terrestrial species. The biogeography of eelgrass in Alaska is discussed, including a survey of biomass, density, chlorophyll concentration, and caloric content. Highest standing stocks are reported for Izembek Lagoon. Standing stock is shown to correlate well with leaf length. The discovery of Zostera growing under ice on the Seward Peninsula is documented. ³²P is used to assess the uptake mechanisms of roots and leaves. Phosphate was shown to be transported rapidly through the plant, rates were highest in the light. Metabolic experiments using oxygen concentration as an indicator were performed. Water temperatures at various sites within the lagoon are correlated with growth patterns.

ACCESS #: 101, IMS-UAF

CITATION : McRoy, C.P. 1968. A Eurasian alga in Alaska. *Pacif. Sci.* 22(1): 138.

KEY-WORDS: *Fucus*; Distribution; Algae; Waterfowl.

SYNOPSIS : The author reports collecting *Fucus inflatus* at Izembek Lagoon. The species had not previously been reported on the west coast of North America. The alga may have been introduced by migrating Steller's Eiders.

ACCESS # : 102, IMS-UAF

CITATION : McRoy, C.P. 1968. The distribution and biogeography of *Zostera marina* (Eelgrass) in Alaska. *Pacif. Sci.* 22(4): 507-513.

KEY-WORDS: *Zostera*; Coastal Alaska; Biogeography; Eelgrass; Izembek Lagoon.

SYNOPSIS : The occurrence of *Zostera* is documented and mapped for coastal Alaska. Distribution is more a function of suitability of habitat than dispersal. Izembek Lagoon is sited as the largest known stand of eelgrass. Plants were discovered as far north as the Seward Peninsula. Biogeography is discussed and similarities with Invertebrate distributions through the Arctic are presented.

ACCESS # : 103, IMS-UAF

CITATION : McRoy, C.P. 1966. The standing stock and ecology of eelgrass (*Zostera marina* L.) in Izembek Lagoon, Alaska. M.S. Thesis. Univ. Washington. 138 pp.

KEY-WORDS: *Zostera*; Standing stock; Izembek Lagoon; Meteorology; Hydrography; Ecology; Eelgrass; Sediments.

SYNOPSIS : Eelgrass biology, distribution and literature is reviewed. The lagoon area is described and climatological data presented. A survey of eelgrass biology in Izembek includes standing stock and productivity measurements. All results are analyzed for statistical differences among sites. A sampling program for eelgrass is presented. Patterns within different grass beds are discussed and differences attributed to temperature. Eelgrass detritus is postulated to support the extensive diversity of mammals, birds, and invertebrates.

ACCESS # : 104, IMS-UAF

CITATION : McConnaughey, T, and C.P. McRoy. 1979. ^{13}C label identifies eelgrass (*Zostera marina*) carbon in an Alaskan estuarine food web. *Mar. Biol.* 53: 263-269.

KEY-WORDS: Carbon uptake; Izembek Lagoon; Food web; Detritus; Eelgrass; *Zostera*.

SYNOPSIS : Naturally occurring ^{13}C is used to trace the Izembek food web. ^{12}C is respired more readily than ^{13}C and therefore successive links in the food chain become more isotopically heavy. Lipids however are isotopically light and have been corrected for in this study using C/N. Quantitative sampling of plants, phytoplankton, invertebrates, birds, and mammals is reported in a table which includes corrected $^{13}\text{C}/^{12}\text{C}$, C/N, and observed diets. The herbivores are closest isotopically to eelgrass while detritus food chains are several times longer. Still the "reasonably short food webs" are capable of supporting the high productivity documented for the lagoon.

ACCESS # : 105, IMS-UAF

CITATION : McConnaughey, T. 1978. Ecosystems naturally labeled with Carbon-13: explications to the study of consumer food-webs. M.S. Thesis. Univ. Alaska. 127 pp"

KEY-WORDS: Food web; Eelgrass; Izembek Lagoon; Tracers; Trophic interactions.

SYNOPSIS : Natural abundance $^{13}\text{C}/^{12}\text{C}$ ratios provide a tracer for the origin of organic carbon in complex coastal marine food webs and also appear to be useful for examining trophic organization and food transfer efficiencies in more strictly oceanic environments. The tracer approach proved useful for analyzing the role of eelgrass (*Zostera marina*) in the food web of Izembek Lagoon, Alaska. Both eelgrass and phytoplankton contribute to the productivity of that community. The analysis was complicated by non-ideal tracer behavior, however. Animal $^{13}\text{C}/^{12}\text{C}$ ratios appeared to depend on biochemical composition, and ways to deal with this were investigated. Furthermore, animal metabolism tended to retain ^{13}C relative to ^{12}C , resulting in progressive elevation of $^{13}\text{C}/^{12}\text{C}$ ratios in the higher trophic levels. By assuming a uniform relation between ^{13}C enrichment and metabolic stoichiometry, it was possible to deduce animal "trophic positions" and food transfer efficiencies from $^{13}\text{C}/^{12}\text{C}$ data taken from the Bering Sea.

ACCESS #: 106, IMS-UAF

CITATION : McCartney, A.P. 1973. Prehistoric cultural integration along the Alaska Peninsula. M.S. Thesis. Univ. Arkansas. 49 pp.

KEY-WORDS: Applegate Cove; Stone tools; Aleuts; Anthropology; Archaeology; Comparative cultures; Izembek Lagoon.

SYNOPSIS : The Alaska Peninsula is important anthropologically because it is the juncture of four important spheres of influence. Excavations at Applegate Cove (Izembek Lagoon) are compared with sites at the base of the Alaska Peninsula. Descriptions of temporary dwellings and one permanent bone house at Izembek along with radio carbon data and artifact information are used to support the hypothesis that the tip of the peninsula represents an integration of cultural types.

ACCESS # : 107, RAS-UAF

CITATION : Jones, R.D., Jr. and D.M. Jones. 1966. The process of family disintegration on Black Brant. Wildfowl Trust. 17th Annual Report. pp 75-78.

KEY-WORDS: Black Brant; Social behavior; Family composition; Izembek Lagoon. Waterfowl.

SYNOPSIS : 34,000 observations were made in the fall of 1965. The Brant arrive in family groups that flock together, ~~seperate~~ from flocks of non-breeding birds. Behavior of these groups is described. A table of populations of adults and juveniles is presented. As birds prepared to continue south family groups began to break up and flocks of families and non-breeders merged.

ACCESS #: 108, RAS-UAF

CITATION : Jones, R.D., Jr. 1970. Reproductive success and age distribution of Black Brant. J. Wildlife Manage. 34(2): 328-333.

KEY-WORDS: Black Brant; Juvenile population; Family composition; Izembek Lagoon; Waterfowl.

SYNOPSIS : Data on reproductive success for the years 1963-1969 is presented. The proportion of juveniles in the population is based on ~~over~~ 140,000 observations. The number of juveniles per family group ranges from 2.6-2.9. The birds' ages were determined through plumage observations. Non-breeding populations are large even when reproductive success is good. A sample calculation for reproductive success using 1966 data is reported.

ACCESS # : 109; RAS-UAF

CITATION : Jones, R.D., Jr. 1965. Returns from Steller's Eiders banded in Izembek Bay, Alaska. Wildfowl Trust. 16th Annual Report. pp 83-85.

KEY-WORDS: Steller's Eiders; Izembek Lagoon; Migration; Nesting; Waterfowl.

SYNOPSIS : Over 200,000 birds migrate through Izembek and Nelson Lagoons and Bechevin Bay. The population peaks in April for the spring migration, the fall arrival is much more "variable" depending on where the birds molt. Males and females segregate during molting. Birds banded in 1961 and 1962 at Izembek were recovered on the Arctic coast of Siberia. A table of recovered birds with recovery sites is included.

ACCESS # : 110, RAS-UAF

CITATION : Jones, R.D., Jr. 1963. An overland migration of fur seals. J. Mammal. 44(1): p 122.

KEY-WORDS: Izembek Lagoon; Cold Bay; Fur seals; Marine mammals.

SYNOPSIS : Two female fur seals (one in 1960 and one in 1962) were observed by the author migrating three miles overland from Izembek Lagoon to Cold Bay.

ACCESS #: 111, IMS-UAF

CITATION : Iizumi, H., A. Hattori and C.P. McRoy. 1982. Ammonium regeneration and assimilation in eelgrass (*Zostera marina*) beds. Mar. Biol. 66: 59-65.

KEY-WORDS: Nitrogen regeneration; Izembek Lagoon; Crane Cove; Nitrogen; Eelgrass; Sediments; Nutrients.

SYNOPSIS : Nitrogen regeneration in sediments is crucial to supporting high productivity in seagrass beds. Expressions are derived for total ammonia, regeneration rates, and assimilation rates in interstitial sediment pools. ^{15}N is used as an experimental tracer. High assimilation versus regeneration rates measured in Japan imply allochthonous nutrient supplies. Data from Izembek indicates that most of the nitrogen required for eelgrass growth is regenerated within the lagoon, while Crane Cove in southeastern Alaska is apparently a sink for external NO_3^- .

ACCESS # : 112, IMS-UAF

CITATION : Iizumi, H., A. Hattori and C.P. McRoy. 1980. Nitrate and nitrite in interstitial waters of eelgrass beds in relation to the rhizosphere. J. Exp. Mar. Biol. Ecol. 47: 191-201.

KEY-WORDS: Izembek Lagoon; Denitrification; Sediments; *Zostera*; Eelgrass; Sediments; Nutrients.

SYNOPSIS : The distribution of NO_3^- - NO_2^- and denitrification in deep anaerobic in Izembek Lagoon in 1977 is discussed. A transect through the lagoon is described in terms of changing plant and sediment characteristics. Plants are larger and less dense at the deep end of the transect compared to the shallower environment. Sediment organics and nutrients also increase with depth. K^{15}NO_3 is added to sediment slurries to determine denitrification rates. Ambient NO_3^- concentrations are anomalously high for reducing sediments. Chamber experiments designed to document oxygen evolution from roots support the hypothesis that light-coupled oxygen exudation into the sediments results in vitrification. The sediments from high organic areas demonstrate the greatest calculated denitrification rates.

ACCESS # : 113, IMS-UAF

CITATION : Iizumi, H. 1979. The nitrogen cycling in eelgrass (*Zostera marina* L.) beds. Ph.D. Dissertation. Univ. Tokyo. 120 pp.

KEY-WORDS: Izembek Lagoon; Crane Cove; Nitrogen uptake; Ammonia regeneration; Sediments; Nitrogen requirements; *Zostera*; Eelgrass; Nutrients.

SYNOPSIS : ^{15}N tracer experiments were performed to determine kinetics of nitrogen uptake. Leaf uptake was found to be proportional to concentration. Translocation to leaves from roots was higher in the light. Nitrogen was translocated from both old leaves and roots to young leaves. NH_4 repressed uptake of $\text{NO}_3\text{-NO}_2$. Phytoplankton and epiphyte productivity is also reported. Growth rates determined from ^{15}C and ^{14}C compared favorably. Derivation of mathematical expressions used to calculate NH_4 regeneration and assimilation are presented. Rates for three lagoon sites from different depths are reported and nitrogen requirements calculated. $\text{NO}_3\text{-NO}_2$ is measured in anoxic sediments and suggested to be a result of oxygen pumping from roots.

ACCESS # : 114, IMS-UAF

CITATION : Goering, J.J. and C.P. McRoy. 1969. Ecology and nitrogen cycle in a marine plant community. Unpublished Annual Progress Report to Federal Water Pollution Control Administration. 11 pp.

KEY-WORDS: Izembek Lagoon; *Zostera*; Algae; Nitrogen uptake; Oceanography; Eelgrass; Nutrients.

SYNOPSIS : This report is essentially a summary of on-going research with comparatively little data. Objectives of the study include quality and character of eelgrass, benthic algae, standing stock and productivity of phytoplankton, and physiological ecology of *Zostera*. Preliminary results suggests that NH_4 uptake is light dependent. Solar radiation and temperature are designated key physical influences. Planned experiments are reported which include measurement of nitrogen fixation and oceanographic characteristics of the lagoon and near-by offshore waters. Inorganic nutrients are reported for the lagoon and offshore, preliminary data.

ACCESS #: 115, RAS-UAF

CITATION : Petersen, M.R. 1978. The feeding ecology of Steller's Eiders. Pac. Seabird Group Bull. 5(1): 33 (Abstract).

KEY-WORDS: Eiders; Waterfowl; Feeding; Trophic interactions; Ecology; Nelson Lagoon.

SYNOPSIS : A report of the foods and feeding behavior of Steller's Eiders at Nelson Lagoon. The primary food of eiders seems to be the mussel, *Mytilus edulis*, supplemented by amphipods, polychaete worms, isopods, clams of the genera *Mya* and *Macoma*, shrimps, and snails.

ACCESS # : 116, NMFS

CITATION : Weber, D.D. 1974. Observations of growth of southeastern Bering Sea king crab, *Paralithodes camtschatica*, from a tag-recovery study, 1955-65. National Marine Fisheries Service, Seattle, WA. Northwest Fisheries Center. Report No. NOAA-NMFS-DR-86; NOAA-74103102. 126 pp.

KEY-WORDS: King crab; Growth; Tagging studies.

SYNOPSIS : Growth data from a ten year tag-recovery study of southeastern Bering Sea king crab, *Paralithodes camtschatica*, were evaluated for sources of error and the usable growth information documented. For simplified analysis of growth data the adult male crab growth increments may be combined since the increase in carapace length, the crab's migratory pattern, molting stage at time of tagging, area of recapture, and selectivity of the fishery can influence interpretation of the growth data. The interaction of these parameters are considered in data application.

ACCESS # : 117, IMS-UAF

CITATION : Warner, I.M. and P. Shafford. 1977. Forage fish spawning surveys - southeastern Bering Sea. Principal Investigators! Reports for the Year Ending March 1977. Vol. 10. p p. 1-64. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Fishes; Spawning; Eulachon; Capelin; Smelt; Herring.

SYNOPSIS : This document presents information on the nearshore spawning stocks of forage fish along the east coast of the Bering Sea with respect to relative abundance, spatial distribution, and basic life history. Aerial surveillance and actual collection of specimens were the approaches employed in conducting the survey.

ACCESS # : 118, NMFS

CITATION : Walters, G.E. 1983. An atlas of demersal fish and invertebrate community structure in the eastern Bering Sea: Part 2, 1971-77. NOAA Technical Memorandum NMFS F/NWC-40. 152 pp.

KEY-WORDS: Demersal fish; Benthic invertebrates; Cluster analysis.

SYNOPSIS : This report presents the results from the second of two studies using numerical classification, i.e., "cluster analysis," techniques to investigate the community structure of demersal fish and invertebrates in the eastern Bering Sea. Annual summer trawl survey data for the years 1971-77 were used to describe apparent habitat areas and species associations, and to examine interannual variability.

ACCESS # : 119, NMFS

CITATION : Walters, G.E. and M.J. McPhail. 1982. An atlas of demersal fish and invertebrates community structure in the eastern Bering Sea: Part 1, 1978-81. NOAA Technical Memorandum NMFS F/NWC - 35. 122 pp.

KEY-WORDS: Demersal fish; Benthic invertebrates; Cluster analysis.

SYNOPSIS : This report presents the results of using numerical classification, i.e., "cluster analysis," techniques to investigate some of the qualitative characteristics of demersal fish and invertebrate community structure in the eastern Bering Sea. Summer trawl survey data from the 4 years, 1978-81, were used to examine relationships between species, describe apparent habitat areas, and measure the extent of interannual variability.

ACCESS # : 120, IMS-UAF

CITATION : Waldron, K.D. 1981. Ichthyoplankton. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 1: 471-493, NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Ichthyoplankton; Larvae; Plankton; Walleye pollock.

SYNOPSIS : Ichthyoplankton studies in the Bering Sea have been conducted since 1955 by Japanese, Soviet, and United States biologists. Comparison and integration of the results of the various surveys is difficult because surveys were conducted during different seasons, different nets and types of tows were used to collect the samples, and different areas were surveyed. Sampling effort was unevenly distributed seasonally with only 1 percent expended during winter, about 9 percent during fall, 35 percent during spring, and 55 percent during summer. Of the approximately 300 species of fish that occur as adults in the Bering Sea, eggs and/or larvae of about 270 species, divided among 137 genera in 34 families, might be expected to be present in plankton samples. Plankton collections made since 1955 contained 60 species divided among 55 genera in 24 families. Families that occurred most frequently in the 26 collections studied were Cottidae (26), Gadidae (23), Hexagrammidae (23), and Stichaeidae (23). Because of differences in seasonal and areal coverage, it is difficult to determine which larvae were, most abundant. For collections made during spring between the Aleutian Islands and about 60 degrees N and centered over the continental slope, larvae of pollock (Theragra chalcogramma) were much more abundant than other species or genus. An adequate knowledge of the ichthyoplankton of the Bering Sea can be gained only by a comprehensive survey, possibly a cooperative effort by Japanese, Soviet, and U.S. vessels and scientists, of at least a year's duration.

ACCESS # : 121, IMS-UAF

CITATION : Waldron, K.D. and B.V. Vinier. 1978. Ichthyoplankton of the eastern Bering Sea. Principal Investigators' Reports for the Year Ending March 1978. Vol. 1. pp. 236-237. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Ichthyoplankton; Walleye pollock; Spawning periods; Vertical distribution; Horizontal distribution; Fishes.

SYNOPSIS : This study mainly focused on walleye pollock, although other Ichthyoplankton were also examined. Data were collected with bongo and neuston nets between mid April and mid May 1977. Most of the eggs and larvae collected were pollock. The report concludes that no marked differences in distribution and abundance of pollock eggs and larvae occurred between 1976 and 1977. Almost all pollock larvae and a majority of pollock eggs were more than 0.25 m below the sea surface.

ACCESS # : 1 2 2 , IMS-UAF

CITATION : Waldron, K.D. and F. Favorite. 1977. Ichthyoplankton of the eastern Bering Sea. Annual Reports of Principal Investigators for the Year Ending March 1977. Vol. IX. pp. 628-682. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Ichthyoplankton; Walleye pollock; Spawning periods; Vertical distribution; Horizontal distribution; Fishes.

SYNOPSIS : Although this study addressed Ichthyoplankton in general, it primarily focused on walleye pollock. Samples of Ichthyoplankton were collected with bongo and neuston nets in the eastern Bering Sea between mid April and mid May 1976. Pollock accounted for most of the eggs and larvae collected. The study revealed that pollock eggs were much more abundant in the upper one meter of the water than below that depth and larvae were more abundant below the one meter depth. The study concluded with the supposition that environmental changes limited to the surface layer would be most damaging to pollock eggs, and changes extending to deeper layers would have a greater effect on pollock larvae.

ACCESS # : 123, IMS-UAF

CITATION : VTN Oregon. 1983a. Cruise Report: Cruise MF 83-1 (RP-MF-83A, Leg 1), 18 April - 7 May 1983, OCSEAP Red King Crab Distribution. VTN Oregon, inc. Willsonville, OR. 5 pp.

KEY-WORDS: King crab; Distribution; Juveniles; Larvae.

SYNOPSIS : Plankton and epibenthic samples were collected in the North Aleutian Basin to determine the apparent distribution of larval and early Juvenile red king crab (Paralithodes camtschatica). Ancillary physical and chemical data for subsequent correlations to the apparent distribution pattern(s) were also gathered. No larval red king crabs were collected before 1 May 1983. Release of larvae was apparently late this year compared to 1982 sampling; half of the adult females examined had laid eggs as of 30 April. Larvae were found at the 50 m stations between Black Hills (on Alaska Peninsula) and Cape Seniavin. A maximum density of approximately 200 Stage I zoeae per 1,000 m³ was observed at station 17. The available data indicated that the larvae vertically migrated over the period studied. Juveniles were collected solely in nearshore rocky areas where colonial tube-forming polychaetes were present. Their apparent distribution was patchy due to the uneven distribution of these regions within Bristol Bay and the low sampling efficiency of the rock dredge. The greatest single catch of these juveniles was in Kvichak Bay. Other "successful" areas included off Port Moller and Cape Seniavin and around the Walrus Islands.

ACCESS # : 124, WILDL. DEPT.-UAF

CITATION : Tack, S.L. 1970. The summer distribution and standing stock of the fishes of Izembek Lagoon, Alaska. M.S. Thesis, University of Alaska, 111 pp.

KEY-WORDS: Fishes; Standing stocks; Izembek Lagoon; Eelgrass.

SYNOPSIS : A small otter trawl and a pushnet were used to quantitatively sample the fishes of Izembek Lagoon, Alaska, during July and August, 1968. Twenty-five species of fish belonging to 11 families were taken in Izembek Lagoon during this study. Most were in Juvenile stages. Three distinct communities were identified: (1) the eelgrass community dominated by the tubenose poacher (Pallasina barbata) and the masked greenling (Hexagrammus octogrammus); (2) the channel community dominated by whitespotted greenling (H. stelleri); and (3) the sand flat community dominated by the Pacific staghorn sculpin (Leptocottus armatus). The tubenose poacher was the only species that spawned during the summer, but both the masked and whitespotted greenlings were gravid at the time sampling was concluded in early August. The standing stock of fishes was estimated at 119.6 kg/ha in eel grass, 73.4 kg/ha in channel, and 21.3 kg/ha on sand flats.

ACCESS # : 125, IMS-UAF

CITATION : Stoker, S. 1981. Benthic invertebrate macrofauna of the eastern Bering/Chukchi continental shelf. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 11:1069-1090. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Benthos; invertebrates; Macrofauna; Communities; Standing stock; Biomass.

SYNOPSIS : This study presents a view of a closely interrelated Bering/Chukchi benthic community system that extends unbroken over the entire continental shelf, with the Chukchi Sea benthos probably relying heavily on Bering Sea for both food supply and recruitment. Indications are that this is a highly productive and relatively stable benthic system composed of at least eight major faunal assemblages of considerable complexity. The environmental factor correlating most strongly with the distribution of these faunal assemblages and with distribution of individual major species appears to be sediment type, but summer bottom temperature and water mass distribution may also be critical. The distribution of standing stock biomass in relation to diversity suggests predation pressure on the southern and northern extremes of the study area, presumably the result of benthic-feeding marine mammal populations and possibly, in the southern region, demersal fish. In general, it appears to be a strongly detritus-based trophic system, with a high standing-stock biomass observed in the Bering Strait and southern Chukchi Sea region, probably the combined result of high near-surface primary productivity" distributions and current structure. The benthic fauna over this region appears to be dominated by boreal Pacific forms, probably also a result of the current structure, with high-arctic forms frequent only in the northern waters.

ACCESS # : 126, IMS-UAF

CITATION : Smith, G.B. 1981. The biology of walleye pollock. In: D.W. Flood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 1: 527-55. NOAA, distrib. by Univ. Washington Press, Seattle, WA

KEY-WORDS: Walleye pollock; Population ecology; Food web.

SYNOPSIS : This document presents biological information on the walleye pollock from the eastern Bering Sea. Population characteristics that are presented include nomenclature, genetic structure, description of habitat, stock size, size and age composition, growth, and reproduction. Within the food web pollock are an important food resource for a wide variety of other fish species, marine mammals, and avifauna. Pollock also represents a major source of predation directed toward zooplankton and cannibalistic behavior. In addition, trawl fisheries harvest approximately 950,000 mt of pollock annually.

ACCESS # : 127, IMS-UAF

CITATION : Smith, R.L., T. McConnaughey, and A.C. Paulson. Fish diets in a subarctic eel grass (*Zostera marina*) -ecosystem. Unpublished manuscript. 19 pp.

KEY-WORDS: Trophic interactions; Eel grass; Fishes; *Zostera*.

SYNOPSIS : Dietary information on 20 fish species inhabiting the eelgrass beds of Izembek Lagoon, Alaska is reported. Fish fed primarily of benthic and epibenthic amphipods, especially caprellids, while predation on infauna and abundant epiphytic mollusks was relatively minor. Piscivory and planktivory were secondary in importance, and no detritivorous or herbivorous fish were captured. Comparison of the Izembek fish fauna with that of Japanese eelgrass beds reveals marked dissimilarity, while the fish of temperate eastern Pacific eelgrass beds are more similar. Despite differences in species composition and reduced diversity, trophic relations on this subarctic eelgrass bed are analagous to those in more temperate regions.

ACCESS # : 128, IMS-UAF

CITATION : Smith, R.L., A.C. Paulson, and J.R. Rose. 1978. Food and feeding relationships in the benthic and demersal fishes of the Gulf of Alaska and Bering Sea. Final Reports of Principal Investigators. Vol. 1. pp. 33-107. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Trophic interactions; Demersal fishes; Predation.

SYNOPSIS : This document presents food and feeding interactions for twelve benthic and demersal fishes. Data were collected on nine species (pollock, rex sole, clover sole, flathead sole, arrowtooth flounder, Greenland flounder, capelin, and shortfin eelpout). A summary of previously existing information on three species (Pacific cod, yellowfin sole, and Pacific halibut) is also presented. Information presented includes analyses of predator size vs. prey composition; bottom type, temperature and location vs. prey composition; prey composition in diets vs. prey abundance; and prey composition vs. season.

ACCESS # : 129, INPFC

CITATION : Simpson, R.R. and H.I. Shippen. 1968. Movement and recovery of tagged king crabs in the eastern Bering Sea, 1955-63. International North Pacific Fisheries Commission Bulletin No. 24. pp 111-123.

KEY-WORDS: King crab; Tagging studies; Migration; Growth.

SYNOPSIS : More than 32,000 adult male king crabs, *Paralithodes camtschatica*, were tagged and released in the eastern Bering Sea in 1955-61. Carapace lengths ranged from 4 to 20 cm. Tagged crabs were recaptured in commercial king crab fisheries of Japan, the U.S.S.R, and the United States; by the end of the 1963 fishing season 14 percent of the tagged crabs had been returned. Tagging and recovery suggests that king crabs of the eastern Bering Sea constitute a single population, in which individuals move and mix randomly. Growth in length of male crabs averaged about 1 cm per year. Half of the tags returned were from crabs caught within 50 nautical miles of the locality of release. The longest distance traveled by a crab in a single year was 230 nautical miles.

ACCESS # : 130, NMFS

CITATION : Shimada A. and J. June. 1982. Eastern Bering Sea Pacific cod food habits. Personal memorandum to staff of the Northwest and Alaska Fisheries Center, Resource Assessment and Conservation Engineering Division. 35 pp.

KEY-WORDS: Pacific cod; Food habits; Trophic interactions.

SYNOPSIS : This document presents preliminary analysis of Pacific cod stomachs that were examined from the southeastern Bering Sea. Approximately half of the stomachs collected have been analyzed and are presented here. For 1980 data, a shift in diet by region was observed. Moving from shallow western waters to deeper waters in the western half of the Bering Sea, it was observed that a diet of crab, euphausiids, and fish changed to a diet chiefly composed of pollock and shrimp. Stomachs from the central region showed neither an extreme of northwestern or southeastern diets but rather a balance between each of the major prey items. In the central region, Tanner crab occurred in 27%, shrimps and euphausiids occurred in 28.1%, and pollock occurred in 27.6% of the stomachs examined. The 1981 results substantiated what was observed in 1980. Of particular interest was the proportion of red king crab in the diet of Pacific cod, 11.2% by weight. Although red king crab represented a significant percentage by weight, the actual frequency of cod predation on red king crab was at a lower percentage (7.3%) as compared to other prey items found in the total sample. The 1981 study was the first to document consumption of red king crab by Pacific cod in the southeastern Bering Sea.

ACCESS # : 131, NMFS

CITATION : Sanger, G.A. 1971. Pelagic amphipod crustaceans from the southeastern Bering Sea. Special scientific report - Fisheries series, NMFS. Report No. NOAA-TR-NMFS-SSRF-680; NOAA-74111805, 13 pp.

KEY-WORDS: Crustacea; Bering Sea; Pelagic zone; Abundance; Animal migrations; Diurnal variation; Zooplankton.

SYNOPSIS : Fourteen species of pelagic amphipods were present in zooplankton samples collected from the southeastern Bering Sea in June 1971. *Parathemisto pacifica* strongly dominated relative abundance. *Primno macropa* was the only other species present in all hauls. *Cyphocaris challenger* and *Hyperliamedusarum* were present. A presumed diurnal vertical migration was evidenced for *Primno macropa*, *Cyphocaris challenger* and possibly for *Scina ratttrayi*, *Hyperoche medusarum*, and *Hyperliamedusarum*. The occurrence of *Scina stebbingi*, *S. ratttrayi*, *Vibilia caeca*, *Paraphronima crassipes*, *Phronima sedentaria*, and *Primno macropa* extended their known range in the Bering Sea eastward, and the occurrence of *Cyphocaris anonyx* represents a new record for the Bering Sea.

ACCESS # : 132, NMFS

CITATION : Otto, R.S., R.A. Macintosh, T.M. Armetta, W.S. Meyers, and K.L. Stahl. 1981. United States crab research in the eastern Bering Sea during 1981. (Document submitted to the annual meeting of the International North Pacific Fisheries Commission, Vancouver, British Columbia, October 1981). 61 pp. NWAFC, NMFS/NOAA, Seattle.

KEY-WORDS: King crab; Tanner crab; Korean hair crab; Population parameters; Tagging studies.

SYNOPSIS : This document contains research conducted during 1981. Included are the results of continued annual trawl surveys and tagging experiments. Populations of red king crabs (*Paralithodes camtschatica*), blue king crabs (*P. platypus*), two species of Tanner crabs (*Chionoecetes bairdi* and *C. opilio*) and Korean hair crab (*Erimacrus isenbeckii*) were the subjects of research.

ACCESS # : 133, IMS-UAF

CITATION : O'Clair, C.E., J.L. Hanson, R.T. Myron, J.A. Gharrett, T.R. Merrell, Jr., J.S. MacKinnon, and N.I. Calvin. 1979. Reconnaissance of intertidal communities in the eastern Bering Sea and the effects of ice-scour on community structure. Final Reports of Principal Investigators. Vol. X. pp.109-415. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Intertidal invertebrates; Community structure; Ice-scour; Algae.

SYNOPSIS : This document examines intertidal communities that have and have not recently been exposed to ice scouring. Species richness and dominance is discussed. The report maintains that the most important characteristic of ice-stressed coasts that allows species to remain in the system is the availability of refuges from ice scouring. Spatial zones and temporal periods are the implications of oil and gas development on these intertidal communities.

ACCESS # : 134, NPFMC

CITATION : North Pacific Fishery Management Council (NPFMC). 1983. Summary of Bering Sea/Aleutian Islands groundfish fishery management plan. Anchorage, Ak. 26 pp.

KEY-WORDS: Demersal fish; Management.

SYNOPSIS : The Bering Sea/Aleutian Islands groundfish fishery management plan was implemented on January 1, 1982. The council has proposed nine amendments to become effective on July 4, 1983. The rest are in the review process. All amendments are incorporated in this summary to reflect the North Pacific Fishery Management Council's most current management of the extensive foreign and domestic groundfish fisheries in the Bering Sea and Aleutian Islands. A history of amendments is included in this summary. .

ACCESS # : 137, NMFS

CITATION : Northwest and Alaska Fisheries Center. 1979-82. Trawl survey data printouts from the southeastern Bering Sea.

KEY-WORDS: Trawl surveys; Demersal fish; Benthic Invertebrates.

SYNOPSIS : Trawl survey data printouts from waters inside the 50 m contour of the southeastern Bering Sea were examined for the years 1979 through 1982. All data were collected during May through August. In all years yellowfin sole and unidentified starfish (presumably *Asterias amurens*) dominated the fish and invertebrate biomasses, respectively. Other dominant fishes were rock sole, walleye pollock and Pacific cod; other dominant invertebrates were king crabs.

ACCESS # : 138, NMFS

CITATION : Northwest and Alaska Fisheries Center. 1982. Cruise results - Cruise No. CH-82-03 NOAA R/V CHAPMAN and Cruise No. PSM-82-01 Chartered Vessel PAT SAN MARIE. Northwest and Alaska Fisheries Center, National Marine Fisheries Center, Seattle, WA. 18 pp.

KEY-WORDS: Crabs; Demersal fish; Resource assessment; Crustacea.

SYNOPSIS : The survey area included eastern Bering Sea continental shelf waters extending from Unimak Pass north along the 100-fathom contour to a latitude of approximately St. Matthews Island and east to the Alaska mainland. This survey examined the crab and groundfish resources by demersal trawling. Biological information and water temperature data were recorded at each station. It was determined that the dominant species within Bristol Bay were yellowfin sole, red king and Tanner crab (*Chionoecetes bairdi*).

ACCESS # : 137, NMFS

CITATION : Northwest and Alaska Fisheries Center. 1979-82. Trawl survey data printouts from the southeastern Bering Sea.

KEY-WORDS: Trawl surveys; Demersal fish; Benthic invertebrates.

SYNOPSIS : Trawl survey data printouts from waters inside the 50 m contour of the southeastern Bering Sea were examined for the years 1979 through 1982. All data were collected during May through August. In all years yellowfin sole and unidentified starfish (presumably Asterias amurensis) dominated the fish and invertebrate biomasses, respectively. Other dominant fishes were rock sole, walleye pollock and Pacific cod; other dominant invertebrates were king crabs.

ACCESS # : 138, NMFS

CITATION : Northwest and Alaska Fisheries Center. 1982. Cruise results - Cruise No. CH-82-03 NOAA R/V CHAPMAN and Cruise No. PSM-82-01 Chartered Vessel PAT SAN MARIE. Northwest and Alaska Fisheries Center, National Marine Fisheries Center, Seattle, WA. 18 pp.

KEY-WORDS: Crabs; Groundfish; Resource assessment.

SYNOPSIS : The survey area included eastern Bering Sea continental shelf waters extending from Unimak Pass north along the 100-fathom contour to a latitude of approximately St. Matthews island and east to the Alaskan mainland. This survey examined the crab and groundfish resources by demersal trawling. Biological information and water temperature data were recorded at each station. It was determined that the dominant species within Bristol Bay were yellowfin sole, red king and Tanner crab (Chionoectes bairdi).

ACCESS # : 139, IMS-UAF

CITATION : McDonald, J., H.M. Feder, and M. Hoberg. 1981. Bivalve mollusks of the southeastern Bering Sea. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. II: 1155-1204. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Bivalves; Distribution; Age composition; Sediments.

SYNOPSIS : Bivalve mollusks and other infaunal species of the southeastern Bering Sea shelf have patchy distributions. The distribution of the bivalves *Nucula tenuis*, *Nuculana fossa*, *Yoldia amygdalea*, *Cyclocardia crebricostata*, and *Spisula polynyma* is associated with specific sediment size, sorting ranges, percentage of mud, and depth. There is little difference in the growth rates of *Nucula tenuis*, *Nuculana fossa*, *Yoldia amygdalea*, *Spisula polynyma*, *Tellina lutea*, and *Macoma calcaria* over the southeastern Bering Sea shelf. Mortality between year-classes for each species of clam varies significantly at specific ages. The variation in year-class composition of specific stations indicates variable annual recruitment success of different areas on the shelf. The data presented here supports Neiman's age-composition hypothesis, which suggests that the prevalence of older bivalve mollusks in the middle zone of the eastern Bering Sea results from the exclusion of predatory bottom fishes by the low winter water temperatures.

ACCESS # : 140, IMS-UAF

CITATION : Macintosh R.A. and D.A. Somerton. 1981. Large marine gastropod of the eastern Bering Sea. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. I 1: 1215-1228. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Gastropod; Snails; Environmental variables.

SYNOPSIS : Gastropods make up to 6-9% by weight of the invertebrates caught on the continental shelf and upper slope of the eastern Bering Sea by research trawl surveys. Five species of the genus *Neptunea* - *N. lyrata*, *N. pribiloffensis*, *N. heros*, *N. ventricosa*, and *N. borealis* - make up 87% of the snail biomass and 69% of the snail numbers. Fifteen of the most common large gastropods were grouped according to the similarity of environmental variables measured at the sampling sites at which each species was found. The variables used were annual maximum bottom temperature and maximum rate of warming. The analysis identified three thermal regions in the eastern Bering Sea in late summer, each region having a distinct assemblage of large gastropod mollusks. *Neptunea* spawn over a protracted period and capsular life of embryos is probably more than six months. Female *N. heros*, *N. lyrata*, *N. pribiloffensis*, and *N. ventricosa* mature at shell lengths of 110, 110, 105, and 102 mm, respectively; males mature at shell lengths of 95, 100, 90, and 87 mm, respectively. Recent studies of *Neptunea* food habits show that a variety of organisms are consumed, including polychaetes, bivalves, barnacles, fishes, and crustaceans. Japan has reported gastropod in the eastern Bering Sea since at least 1971. Reported catch rates range from 0.9 to 4.0 kg/pot and total Japanese catch has varied from 404 to 3,574 mt of edible meat per year.

ACCESS #: 141, IMS-UAF

CITATION : Jewett, S.C. and H.M. Feder. 1981. Epifaunal invertebrates of the continental shelf of the eastern Bering and Chukchi Seas. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. II: 1131-1153. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Epifauna; Invertebrates; Benthos; Biomass.

SYNOPSIS : Epifaunal Invertebrates were surveyed over much of the eastern Bering and Chukchi seas continental shelf. Information on the distribution, abundance, and biomass of the dominant species is discussed by area and depth strata. Four commercially important crabs (*Paralithodes camtschatica*, *P. platypus*, *Chionoecetes opilio*, and *C. bairdi*) and four sea-star species (*Asterias amurensis*, *Evasterias echinosoma*, *Leptasterias polaris acervata*, and *Lethasterias nanaimensis*) account for nearly 70% of the epifaunal biomass of the entire eastern shelf region. Commercially-important crabs dominate the southeastern portion of the shelf; echinoderms, in particular sea stars, abound in the northeastern Bering Sea and southeastern Chukchi Sea. The 20-40 m depth stratum of the SEBS was dominated (biomass) by echinoderms, particularly the sea star *Asterias amurensis*.

ACCESS # : 142, IMS-UAF

CITATION : Incze, L.S., D.A. Armstrong, and D.L. Wencker. 1982. Rates of development and growth of larvae of *Chionoecetes bairdi* and *C. opilio* in the southeastern Bering Sea. In: Proc. of the Int. Symp. on the Genus *Chionoecetes*. Lowell Wakefield Fish. Symp. Ser., Alaska Sea Grant Rep. No. 82-10. pp 191-218.

KEY-WORDS: Crabs; *Chionoecetes*; Zooplankton; Development; Growth; Larvae; Crustacea.

SYNOPSIS : Several aspects to the biology of larvae of *Chionoecetes bairdi* and *C. opilio* were investigated using zooplankton samples collected in the southeastern Bering Sea from 1978-1981. Large numbers of first stage zoeae of *C. bairdi* appeared in the plankton during late April and early May in the years sampled. The larvae of *C. opilio* appeared in significant numbers in the plankton at least two weeks prior to the major hatch-out of *C. bairdi* during two years and limited data from two other years indicates that this regularly occurs. Data on the timing of appearance of larvae in the plankton and on frequency of molting in larval populations of the two species indicate an approximate 30-day minimum to the duration of each zoeal stage and a 30 to 40-day hatch-out period. The duration of the megalops stage may be longer than 30 days for a significant proportion of the larvae of both species. A method for examining growth of zoeae in the field is described and a growth rate of approximately 5% dry weight zoea⁻¹ day⁻¹ calculated. The predicted ingestion rates necessary to satisfy growth requirements are briefly discussed.

ACCESS # : 143, IMS-UAF

CITATION : Hughes, S.E. and N.Bourne. 1981. Stock assessment and life history of a newly discovered Alaska surf clam (*Spisulapolynyma*) resource in the southeastern Bering Sea. Can. J. Fish. Aquat. Sci. 38: 1173-1181.

KEY-WORDS: Population assessment; Sustainable yield; Surf clams.

SYNOPSIS : A 1977 exploratory survey of subtidal clam resources in the southeastern Bering Sea revealed extensive concentrations of Alaska surf clams (*Spisulapolynyma* Stimpson) along the north coast of Alaska Peninsula. Using east coast hydraulic clam harvesters, subsequent 1977 and 1978 stock assessment surveys delineated a geographically isolated stock with an estimated exploitable biomass of 329,000 + or - 52,000 mt and conservatively calculated potential annual yield of 25,017 mt (maximum sustainable yield) of whole clams. Production fishing trials at 13 sites in 1978 produced an average catch per unit effort of 815 kg/h with a 1.84-m-wide clam harvester. Life history studies indicated the species is long-lived (25 yr), slow growing ($k=0.135$), fully recruited to the spawning population at 8 yr of age, subject to low natural mortality (conservatively calculated as $M=0.19$), and attains maximum cohort biomass at ages between 9.4 and 13.0 yrs. Biological rationale for management measures is presented.

ACCESS # : 144, IMS-UAF

CITATION : Haynes, E., J.F.Karinen, J. Watson, and D.J. Hopson. 1976. Relation of number of eggs and egg length to carapace width in the brachyuran crabs *Chionoecetes bairdi* and *C. opilio* from the southeastern Bering Sea and *C. opilio* from the Gulf of St. Lawrence. J. Fish. Res. Bd. Can. 33: 2592-2595.

KEY-WORDS: Crabs; *Chionoecetes*; Fecundity; Crustacea.

SYNOPSIS : The number of eggs attached to pleopods of *Chionoecetes bairdi* and *C. opilio* from the southeastern Bering Sea increased at a rate proportional to about 3.4 and 2.7 power of the carapace width, respectively, but for *C. opilio* from the Gulf of St. Lawrence it increased to the 4.2 power. The range in carapace width and number of eggs for crabs from the Bering Sea of a given carapace width were considerably greater for *C. bairdi* than for *C. opilio*. In the southeastern Bering Sea, the reproductive potential for adult females of *C. bairdi* with mixed spawning history is approximately 4 times greater than that of *C. opilio* spawning for the first time. *Chionoecetes opilio* females with mixed spawning history in the Gulf of St. Lawrence carry more eggs for a given carapace width than first-time spawners from the southeastern Bering Sea. Gravid *C. bairdi* occur within the nearshore region of the southeastern Bering Sea, as well as in deeper waters of the shelf.

ACCESS # : 145, IMS-UAF

CITATION Maynes, E.B. 1974. Distribution and relative abundance of larvae of king crab, Paralithodes camtschatica, in the southeastern Bering Sea, 1969-70. Fish. Bull. 72: 804-812.

KEY-WORDS: King crab; Paralithodes camtschatica; Larvae; Distribution; Abundance; Marine biology; Shellfish; Plankton; Crustacea; Animal migrations.

SYNOPSIS : During the spring and summer of 1969 and 1970, larvae of king crab, Paralithodes camtschatica, were abundant in plankton samples from the southeastern Bering Sea. Abundance was highest near shore and generally lowest in the central and western parts of the study area. As the season progressed, the center of abundance moved northwestward along the Alaska Peninsula toward the head of Bristol Bay. This change in distribution was apparently related to water current patterns.

ACCESS # : 146, IMS-UAF

CITATION : Haflinger, K. 1981. A survey of benthic infaunal communities of the southeastern Bering Sea shelf. in: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. II: 1091-1103. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Benthos; Infauna; invertebrates; Standing stock; Communities; Frontal zones.

SYNOPSIS : The continental shelf of the Bering Sea south of St. Matthew island was surveyed by taking at least five van Veen grabs at each of 96 stations and sieving organisms with a 1-mm mesh screen. Multivariate statistical methods were used to define communities organized in roughly contiguous bands paralleling local bathymetry. Community boundaries coincide with frontal zones identified in the area, suggesting a community response to water-mass characteristics or differing between-front depositional environments. Large between-station variations within the same sedimentary and temperature regimes were noted, but cannot be interpreted with the existing data. Standing stocks appeared uniformly low away from areas with a coastal influx of detritus, with the exception of an area southeast of the Pribilof islands that seems to underlie an intensely productive water column.

ACCESS # : 147, IMS-UAF

CITATION : Golia, A. 1981. Bristol Bay: A regional fisheries development plan. Unpublished manuscript. Fisheries Program, Bristol Bay Native Association, Dillingham, Ak. pp. 53-65.

KEY-WORDS: Bristol Bay; Fisheries resources.

SYNOPSIS : Included in this document are abbreviated development plans for bottomfish and surf clam fisheries for the Bristol Bay region.

ACCESS # : 148, INPFC

CITATION : Forrester, C.R., A.J. Beardsley, and Y. Takahashi. 1978. Groundfish, shrimp, and herring fisheries in the Bering Sea and northeast Pacific - historical catch statistics through 1970. International North Pacific Fisheries Commission Bulletin No. 37. 147 pp.

KEY-WORDS: Commercial fisheries; Demersal fish; Shrimp; Herring.

SYNOPSIS : In this document the history of the fishery in the North Pacific Ocean and statistics of total catch are discussed in a general chronological order, i.e., from aboriginal times, through the periods of peak production (by some nations) associated with World Wars I and II, to and including the fisheries of the 1960s. A general summary of the fishing activities of each nation and nations combined is presented. Some historical figures of fisheries on particular species of interest to one or more nations have also been discussed. General observations of fishing vessels and gear used by various nations in particular fisheries are presented.

ACCESS # : 149, IMS-UAF

CITATION : Feder, H.M. and S.C. Jewett. 1981. Feeding interactions in the eastern Bering Sea with emphasis of the benthos. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. II: 1229-1261. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Trophic Interactions; Predation; Benthos; Fishes.

SYNOPSIS : The benthos of the northeastern Bering Sea, which accounts for 86% of the total benthos on the eastern shelf, supports reduced numbers of demersal fishes, presumably due to low-temperature barriers normally present. In the southeastern Bering Sea, where 23% of the food benthos of the eastern shelf is found, bottom fishes have year-round access to food resources. Major fisheries for crabs and bottom fishes occur in the southeastern portion of the Bering Sea. Most predators feed on the upper continental slope in winter, but move to shallower and warmer waters of the shelf in late spring and summer. Slow growth is characteristic of benthic invertebrates used as food on the Bering Sea shelf. However, bottom-feeding species on the slope and shelf edge probably also eat zooplankters, as these organisms accumulate on the bottom after death. Periodic organic carbon enrichment of the shelf, resulting from a poorly coupled organic carbon system, also enhances food resources on the bottom and may result in a more frequent recruitment successes for infaunal species. Organic carbon enrichment of the southeastern Bering Sea shelf is indicated by dense populations of deposit-feeding bivalve mollusks, a general increase in other infauna and high densities and biomass of epifauna.

ACCESS # : 150, IMS-UAF

CITATION : Feder, H.M., A.J. Paul, and J.M. Paul. 1978b. The pinkneck clam *Spisulapolynyma* in the eastern Bering Sea - growth, mortality, recruitment and size at maturity. Sea Grant Report No. 78-2, Inst. Mar. Sci., Univ. Alaska, Fairbanks. Rep. No. R-78-2. 26 pp.

KEY-WORDS: Pinkneck clam; Surf clam; *Spisulapolynyma*; Growth; Mortality; Recruitment; Maturity.

SYNOPSIS : Specimens for this study were collected in the summer of 1977. Growth histories of 15 year classes were determined by measuring the lengths of every annulus. Annual increases in shell length were typically 7 to 16 mm. The majority, 77%, of the clams were 9 years of age or older. The preponderance of older clams in samples was due to gear bias. The oldest clams were 16 years old. Two methods were used to calculate mortality rates for age classes 12 through 16. The estimated rates of natural mortality for these year classes were 9%, 27%, 40%, 67%, and 100%, respectively.

ACCESS # : 151, IMS-UAF

CITATION : Feder, H.M., J. Hilsinger, M. Hoberg, S.C. Jewett, and J. Rose. 1978a. Survey of the epifaunal invertebrates of the southeastern Bering Sea. Principal Investigators? Reports for the Year Ending March 1978. Vol. IV. pp. 1-126. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Epifauna; Trophic interactions.

SYNOPSIS : The 1975-76 trawl study considered in this report delineates the major epifaunal species on the eastern Bering Sea shelf in regions of offshore oil and gas concentrations. Data were obtained on faunal composition and abundance which now are baselines to which future changes can be compared. Long-term studies on life histories and trophic interactions should define functional aspects of communities and ecosystems that are vulnerable to damage, and should help to determine the rates at which damaged environments can recover. Assessment of all data suggests that: sufficient station uniqueness exists to permit development of monitoring programs based on species composition at selected stations utilizing trawl techniques. Adequate numbers of biologically well-known, unique and/or large species are available to permit nomination of likely monitoring candidates once industrial activity is initiated.

ACCESS # : 152, IMS-UAF

CITATION : Wencker, D.L., L.S. Incze, and D.A. Armstrong. 1982. Distinguishing between *Chionoecetes bairdi* and *C. opilio* zoeae collected in the southeast Bering Sea. In: *Proceedings of the Int. Sym. of the Genus Chionoecetes*. Lowell Wakefield Fisheries Symposia Series, Ak. Sea Grant Rep. No. 82-10, pp 219-230.

KEY-WORDS: Crabs; Larvae; Taxonomy; *Chionoecetes*; Crustacea.

SYNOPSIS : Three morphological characteristics which enable separation of zoeae larvae of *Chionoecetes bairdi* and *C. opilio* are discussed; two are described here for the first time. Use of all three characteristics enables species identification of most *Chionoecetes* zoeae found in plankton samples from the southeastern Bering Sea.

ACCESS # : 153, PMEL

CITATION : Feely, R.A., G.J. Massoth, A.J. Paulson, M.F. Lamb and E.A. Martin. 1981. Distribution and elemental composition of suspended matter in Alaskan coastal waters. NOAA Technical Memo ERL-PMEL-27. Pacific Marine Environmental Laboratory, Seattle. 119 pp.

KEY-WORDS: Particulate matter; Elemental composition; organic matter; C/N ratio; Unimak Pass; Kuskokwim Bay.

SYNOPSIS : This is a comprehensive study of the distribution and chemical composition of suspended material on the continental shelves of Alaska. The purpose of the study was to determine the chemical nature and transport pathways of particulate matter which would act as effective scavengers of petroleum compounds in the shelf waters. The report summarizes studies of northeast Gulf of Alaska, lower Cook Inlet, southeastern Bering Sea Shelf, and Norton Sound. Southeastern Bering Sea data were obtained September-October, 1975 and June-July 1976. Surface water particulate matter was found to be dominated by input from northern rivers notably the Kuskokwim, Togiak, Igushik, Kvichak, and Nushagak rivers. The material originating from these rivers is over 76% inorganic and of terrestrial origin: high concentrations of particulate matter (> 6 mg/l) were found near shore along the Alaska Peninsula 5 m from the bottom in September-October with much less at the surface (> 2 mg/l) in June-July. High surface values (> 6 mg/l) were found near Unimak Pass and along the coast beginning up near Port Moller and extending eastward. In the high concentration areas the organic matter is thought to be primarily of marine origin because of its C/N ratio. Total particulate carbon in the near shore region in Bristol Bay is in excess of 300 $\mu\text{g/l}$.

ACCESS #: 154, IMS-UAF

CITATION : Griffiths, R.P., B.A. Caldwell, W.A. Broich, and R.Y. Morita. 1983. Microbiological processes relating to carbon cycling in southeastern Bering Sea sediments. Mar. Ecol., Prog. Ser. 10: 265-275.

KEY-WORDS: St. George Basin; Port Moller; Microbiological activity; Respiration; Carbon dioxide; Carbon cycling; Methane production; Nitrogen fixation; Carbon dioxide production; Laminarinase.

SYNOPSIS : Carbon dioxide production rates in St. George Basin sediments ranged from 0.1 to 6.2 nmol/g/hr as compared to Port Moller which ranged from 5 to 48 nmol/g/hr . Respiration in salt marsh soils have been observed from 11 to 567 nmol/g/hr . Methane production rates in SGB were 0.00028-0.019 nmol C/g/hr and 0.0011-2.5 nmol C/g/hr in Port Moller. Laminarinase activities were lower in SGB than Port Moller. The data indicate an insignificant impact of laminarinase to SGB. Mean nitrogen fixation rates in sediments were 360 $\mu\text{g N/m}^2/\text{hr}$ in SGB and 540 $\mu\text{g N/m}^2/\text{hr}$ in Port Moller.

ACCESS #: 155, IMS-UAF

CITATION : Griffiths, R.P., B.A. Caldwell, J.D. Cline, W.A. Broich and R.Y. Morita. 1982. Field observations of methane concentrations and oxidation rates on the southeastern Bering Sea. Appl. Environ. Microb. 44: 435-446.

KEY-WORDS: Methane; Methane oxidation; Port Moller; Microbiological activity.

SYNOPSIS : Paper stressed the lack of information of the effect of environmental factors on methane oxidation in the marine environment. Highest rates are to be expected in areas of high suspended particulate matter.

ACCESS # : 156, IMS-UAF

CITATION : Koike, T., K. Furuya, H. Otake, T. Nakai, T. Memoto and A. Hattori. 1982. Horizontal distributions of surface chlorophyll a and nitrogenous nutrients near Bering Strait and Unimak Pass. Deep Sea Res. 29: 149-152.

KEY-WORDS: Nitrate; Unimak Pass; Chlorophyll a; Vertical mixing; Alaska stream; Primary production.

SYNOPSIS : Data on chlorophyll a, nitrogenous nutrients, temperature, and salinity in the surface waters of Unimak Pass show some vertical mixing in the pass with an inverse relationship between nitrate and chlorophyll. In the southern Bering Sea west of the pass chlorophyll a exceeds 3 ug/l and nitrate was near zero indicating rapid utilization of pass provided nutrients in nutrient primary production.

ACCESS # : 157, IMS-UAF

CITATION : Hood, D.W. and W.S. Reeburgh. 1972. Chemistry of the Bering Sea: an overview. In: D.W. Hood and E.J. Kelley (eds.), Oceanography of the Bering Sea. Occ. Pub. No. 2. Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp. 191-204.

KEY-WORDS: Chemistry; Sediment-water interaction; Isotopes; Sea ice chemistry; Radon/radium exchange studies.

SYNOPSIS : In this overview paper much of the chemical work completed on the Bering Sea at the time of writing is reviewed and suggestions are made to its importance and to future needs for further investigation. Sediment-water interaction is thought to be of particular importance in the interstitial waters. The effect of ice on sea water chemistry is discussed. The use of Rn-222 and Ra-226 in studying mixing in the ocean is discussed as is the use of stable isotopes.

ACCESS # : 158, IMS-UAF

CITATION : Loder, T.C. 1971. Distribution of dissolved and particulate organic carbon in Alaskan polar, sub-polar and estuarine waters. Ph.D. Dissertation, Inst. Mar. Sci., Univ. Alaska, Fairbanks. 236 pp. Section V3 on Unimak Pass. pp. 147-159.

KEY-WORDS: Dissolved organic carbon; Particulate organic carbon; Unimak Pass; Transmissivity; Absorbance.

SYNOPSIS : Data on dissolved organic carbon (DOC) and particulate organic carbon (POC) in Unimak Pass area were collected on R/V Acona cruise 027 July 27 to August 9, 1966. Five stations were reoccupied several times during the cruise. Sixteen stations in all were visited. DOC values ranged from 0.60 to 1.90 mg C/l with an average of 1.20 mg C/l for depths less than 100m. POC values varied only 1.2 percent from a mean value of 741 µg C/l in the top 16 m of the water column. Transmissivity of surface waters was measured at seven stations. The calculated absorbance correlated well with the POC content of the water.

ACCESS # : 159, IMS-UAF

CITATION : Holmes., R.W. 1958. Surface chlorophyll a, surface primary production, and zooplankton volumes in the Eastern Pacific Ocean. Rapp. Proces. Verb. Reunions. Cons. Perm.Int.Explor. Mar. 144: 109-116.

KEY-WORDS: Unimak Pass; Primary production; Chlorophyll a.

SYNOPSIS : Limited data on productivity in Unimak Pass indicates Unimak Pass to have the highest level of productivity in North Pacific.

ACCESS # : 160, IMS-UAF

CITATION : Kelley, J.J., L.L. Longerich and D.W. Hood. 1971. Effect of upwelling, mixing and high primary productivity on CO₂ concentrations in surface waters of Bering Sea. J. Geophys. Res. 76: 8687-8693.

KEY-WORDS: Partial pressure of CO₂ (pCO₂); Upwelling; Samalga Pass; Amutka Pass; Primary production.

SYNOPSIS : Late spring and early fall measurements of DCO₂ were made in Bering Sea surface waters north of Amutka and Samalga Passes in the eastern Aleutian Islands. High values of CO₂, NO₃⁻, and salinity were accompanied by low oxygen and temperature values. All the isopleths of these parameters give evidence of vertically mixed water. Seasonal low values of CO₂ in surface waters were observed in areas of low vertical mixing and high primary productivity.

ACCESS # : 161, IMS-UAF

CITATION : Hood, D.W. Unpublished. Cruise 261-5 of RV Acona to Unimak Pass and North Alaskan Peninsula. Inst. Mar. Sci., Univ. Alaska, Fairbanks.

KEY-WORDS: Partial pressure of CO₂ (pCO₂); Upwelling; Unimak Pass; Amak Island.

SYNOPSIS : Limited salinity, temperature, and carbon dioxide data were obtained in the Unimak Pass area in June 1978. Severe storms limited station occupation on the ten day cruise, however 10 stations were occupied in a long shore transect from west of Unimak Pass to Amak Island north of Izembek Lagoon. At all stations pCO₂ of the surface water was found to be near or less than air values indicating no evidence of upwelling in the region on this occasion.

ACCESS # : 162, IMS-UAF

CITATION : Hood, D.W. and L.A. Codispoti. 1980. Carbon budgets and transfer in the southeast Bering Sea. In: PROBES Progress Report, Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp. 163-189.

KEY-WORDS: Inorganic carbon; Total carbon dioxide; Community production; Alkalinity; pH.

SYNOPSIS : Data on the inorganic carbon system were obtained on the Southeast Bering Sea PROBES cruises aboard the R/V TG Thompson from 23 March to 4 June, 1980. Net community organic carbon production computations gave an average value of 2.5 gm²/day for the period 12 April to 23 May. Corrections of net total carbon losses by 33% to allow for estimated calcium carbonate precipitation were included in the net community organic carbon production value but no allowance was made for atmospheric transfer or convective inputs. Surface oxygen values were obtained at all 1 stations.

ACCESS # : 163, IMS-UAF

CITATION : Hood, D.W. and L.A. Codispoti. 1981. Carbon budgets and transfer in the Southeast Bering Sea. In: PROBES Progress Report for 1981. Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp. 131-157.

KEY-WORDS: Inorganic carbon; Carbon dioxide; C/N ratio; Regeneration; Community production; Dissolved oxygen; Primary production.

SYNOPSIS : Data on the inorganic carbon system was obtained in the southeast Bering Sea on all PROBES stations taken aboard the R/V TG Thompson in 1981. The loss of total inorganic carbon dioxide to the biota was studied in detail during the spring bloom and for about one month into the post bloom period. A decrease in inorganic carbon coincided with a decrease in nitrate during the spring bloom at a ratio of about 17 atoms to 1. in the post bloom period inorganic carbon showed rapid recovery for a short period in late June at some stations but was interrupted by major oceanographic events in mid July. This brought in a new supply of nutrients to most stations resulting in a minor, secondary bloom. Because the cruise ended soon after, it was not possible to collect data for the complete recovery (regeneration) period. Surface oxygen concentrations are given for all stations occupied.

ACCESS # : 164, IMS-UAF

CITATION : Hood, D.W. and L. A. Codispoti. 1983. The effect of primary production on the carbon dioxide components of the Bering Sea shelf. in: The potential effects of carbon dioxide induced climatic change in Alaska, Jennifer H. McBeath (ed). School of Agriculture, Univ. Alaska, Fairbanks. In press.

KEY-WORDS: inorganic carbon; Carbon dioxide; Primary production; Nitrate/carbon dioxide relations; Oxygen; Partial pressure of CO₂; Total carbon dioxide.

SYNOPSIS : Processes associated with primary production in the surface waters of the eastern Bering Sea shelf reduce the partial pressure of gaseous carbon dioxide (pCO₂) in the surface water from equilibrium with air winter time values of about 340 UA to as low as 150 UA at the end of spring bloom in June. The total inorganic carbon content in the surface water at one station reduced from 2.05 mM/l in early April to 1.70 mM/l at the beginning of June. Nitrate concentration reduced from 20 ugA/l in April to about 0 ugA/l in June. The carbon to nitrate uptake ratio for this period was 17 to 1. By June first on the Bering Sea Shelf 100-200 gC/M² of inorganic carbon is tied up as organic carbon in the average year. Some of this carbon will be replaced by atmospheric carbon by exchange of CO₂ through the sea surface and part from respiration by biota. The opportunity exists for some of the organic carbon to be lost to the deep ocean basin to be replaced in the shelf water column by atmospheric carbon dioxide. if all high latitude shelves behave in a similar way to the Bering Sea shelf as there is evidence they do, then the potential for biological fixation of organic carbon and subsequent transfer of part of this organic carbon to the deep sea possibly provides a useful mechanism for helping balance the global carbon budget, however, much consideration must still be given to the demands of the biota of the shelf region for fixed carbon before excesses over that required can be shown to be available for ocean transport.

ACCESS # : 165, IMS-UAF

CITATION : Kelley, J.J. and D.W. Hood. 1971. Carbon dioxide in the Pacific Ocean and Bering Sea: upwelling and mixing. J. of Geophys. Res. 76: 745-752.

KEY-WORDS: Inorganic carbon; Carbon dioxide; Partial pressure of CO_2 (pCO_2); Upwelling; Primary production.

SYNOPSIS : This a good descriptive paper comparing pCO_2 between air and water over vast areas of the North Pacific Bering Sea and southeast Pacific. Unimak Pass data for late July and early September show between 15 and 30 ppm greater pCO_2 in water than air for both sampling periods.

ACCESS #: 166, IMS-UAF

CITATION : Longerich, L.L., J.J. Kelley, and D.W. Hood. 1971. Carbon dioxide in the surface waters near the coast of southern Alaska and eastern Aleutian Islands. In: Oceanography of the Bering Sea. Phase I. D.W. Hood et al. Inst. of Mar. Sci., Univ. of Alaska Report No. R-71-9. pp. 3-58.

KEY-WORDS: Partial pressure of CO_2 (pCO_2); Carbon dioxide; pCO_2 /nitrate; Upwelling; Primary production; Izembek lagoon; Eelgrass; Phytoplankton.

SYNOPSIS : This report describes in detail the methodology used in measuring the partial pressure of carbon dioxide (pCO_2) in air and surface sea water. Extensive data are presented on pCO_2 values for the Alaska Peninsula and eastern Aleutian passes. In June pCO_2 was found deficient (-) with respect to air in excess of 100 ppm at all locations except near Samalga and Amukta Passes where it was greater (+) than air by over 100 ppm because of upwelling. In September upwelling was still found at Samalga Pass and small positive values were found in Unimak Pass (+ 10 to 100 ppm). Amukta Pass was not revisited. All other stations showed near equilibrium or negative (-10 to -100) pCO_2 (w) values. Seasonal data in Izembek Lagoon are reported. Strong correlations between pCO_2 (w) and nitrate was observed in upwelled waters.

ACCESS # : 167, IMS-UAF

CITATION : Hood, D.W. 1981. Preliminary observations of the carbon budget of the eastern Bering Sea shelf. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. : 347-358. NOAA, Distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Partial pressure of CO₂ (pCO₂); Carbon budget; pCO₂/NO₃- correlation; Diurnal changes; Upwelling; Total carbon dioxide.

SYNOPSIS : This paper shows pCO₂ distribution near Unimak Pass as well as the shelf region north to the Pribilof Islands for the outer domain (seaward of 100 m) and for the middle and outer domain in 1978. This type of information has particular value in observing regions of vertical mixing, fresh water input and primary productivity. Some diurnal and pH data are also given.

ACCESS # : 168, IMS-UAF

CITATION : Venkatesan, M.I., M. Sandstrom, S. Brenner, E. Ruth, J. Bonilla, I.R. Kaplan and W.E. Reed. 1981. Organic geochemistry of surficial sediments from the eastern Bering Sea. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 1: 389-409. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Hydrocarbons; Organic carbon; Sediments; Lipids; Humic acid; Lagoons; Organic geochemistry.

SYNOPSIS : Stations in the North Aleutian region were some distance offshore, however some implications can be drawn regarding origin of humic material.

ACCESS # : 169, RAS-UAF

CITATION : Venkatesan, M.I. and I.R. Kaplan. 1982. Distribution and transport of hydrocarbons in surface sediments of the Alaskan Outer Continental Shelf. *Geochem. Cosmochem. Acts* 46: 2135-2149.

KEY-WORDS: Hydrocarbons; Oil seep; Polynuclear aromatic hydrocarbons; Alkenes; Terrigenous lipids.

SYNOPSIS : This paper summarizes the hydrocarbon data for all the outer continental shelves of Alaska obtained by these authors and others. Little evidence of petroleum hydrocarbons was found but the presence of n-alkenes implies slow oxidation conditions in some of the depositional areas. In southeast Bering Sea, unlike other regions, hydrocarbons are low in the coarse grained near shore sediments and higher in fine grained sediments near the shelf edge. In general, the area is pristine with few abiological components. One station near the shelf break of the southeast Bering Sea showed some evidence of an oil seep.

ACCESS # : 170, IMS-UAF

CITATION : Sharma, G.D. 1971. Bristol Bay: model contemporary graded shelf In: *Oceanography of the Bering Sea. Phase I. Turbulent upwelling and biological productivity mechanisms in the southeastern Bering Sea and Aleutian Islands.* D.W. Hood et al. Rep. No. R-71-9. Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp. 107-137.

KEY-WORDS: Sediments; Graded shelf; Sediment sources; Clay mineralogy; Feldspars; Organic carbon content; Storm waves.

SYNOPSIS : Much of the sedimentation distribution observed is explained on the basis of a strong, central, core countercurrent in Bristol Bay which was believed to be the case at the time but has since, with greater evidence, been found not to exist.

ACCESS # : 171, IMS-UAF

CITATION : Handa, N. and E. Tanoue. 1981. Organic matter in the Bering Sea and adjacent areas in the Bering Sea shelf. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 1: 359-381. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Particulate matter; Organic nitrogen; Chlorophyll a; Amino acids; Monosaccharides; Fatty acids; Biological degradation; Dissolved organic matter.

SYNOPSIS : This paper is of particular value in relating composition of particulate material especially with respect to composition of organic matter. Of particular value is Fig. 23.9 which relates the POC/chlorophyll a, PON salinity, and temperature at stations east and south of the Pribilof Islands. Unfortunately, no stations were in the near shore region of the North Aleutian Shelf.

ACCESS #: 172, IMS-UAF

CITATION : McConnaughey, T. and C.P. McRoy. 1976. Food-web structure and the fractionation of carbon isotopes in the Bering Sea. Pp. 296-316 In: Science in Alaska. Proc. 27th Alaska Sci. Conf., Fairbanks, Alaska. Resource Development - Processes and Problems. Vol. 2. Alaska Div. AAAS.

KEY-WORDS: Carbon Isotopes; Food web; Plankton; Benthos; Fishes; Marine mammals; Seabirds.

SYNOPSIS : This paper provides $^{13}\text{C}/^{12}\text{C}$ ratios for 21 species of invertebrates, 7 species of fishes, 2 marine mammals, 1 seabird and mixed phytoplankton and zooplankton. A trophic structure model is constructed based on the fractionation of carbon isotope ratios by the biota. Gives more details than the 1979 paper by the same authors but the conclusions are the same.

ACCESS # : 173, IMS-UAF

CITATION : Dennison, W. 1979. Light adaptations of plants: a model based on the seagrass *Zostera marina* L. Ms. Thesis, Univ. of Alaska, Fairbanks. 70 pp.

KEY-WORDS: Chlorophyll ratios; Izembek Lagoon; Light limitation; Leaf area index; Eelgrass.

SYNOPSIS : Options available to plants for low light environments are presented. Sun reflectors and shades were used to document light adaptations in *Zostera* along a depth gradient in Izembek Lagoon. Chlorophyll a and b ratios are assessed and found to be close to optimal for maximum efficiency energy gain. Ratios were higher in deeper plants. Light manipulations had little effect on shallow eelgrass suggesting other limits on plant growth than light. Change in leaf area was determined to be the major light adaptation mechanism. Increased leaf area also increased habitat complexity.

ACCESS # : 174, IMS-UAF

CITATION : Smith, R.L. and A.C. Paulson. 1977. Osmoregulatory seasonality and freezing avoidance in some fishes from a subarctic eelgrass community. *Copeia* (2): 362-369.

KEY-WORDS: izembek Lagoon; Fish; Osmoregulation; Migration; Eelgrass.

SYNOPSIS : Of 23 species examined, 7 were determined to be year round residents. A table of species and dates sampled is presented. Serum electrolytes, measured as Na⁺ concentration, decreased with increasing osmolarity. it was assumed that ether compounds were used to osmoregulate because considerable adjustment was documented. Fish that could not tolerate freezing conditions migrated either out of the lagoon into deeper water, or into fresh water streams.

ACCESS # : 175, WILDL. DEPT.-UAF

CITATION : Morehouse, K.A. 1974. Development, energetic, and nutrition of cap-hive Pacific Brant (Branta bernicla orientalis, Tongarinov). Ph.D. Dissertation. Univ. of Alaska, Fairbanks. 104 pp.

KEY-WORDS: Brant; Growth rates; Growth requirements; Metabolism; Alaska. Eelgrass; Waterfowl.

SYNOPSIS : This work explores the energy relationships of young and adult Brant along with nutrition and growth and development of juveniles. Eggs collected on the Yukon-Kuskokwim delta were hatched in Fairbanks. Data on growth rates, metabolic rates, response to temperature, heart rate, and activity patterns are presented and compared. Several diets were tested containing various proportions of Zostera. Captive birds developed faster than wild birds, but eelgrass was shown to be a poor food source. The author suggests that early removal from the nest may have precluded the development of important microbial flora and hence made digestion inefficient in captive birds.

ACCESS # : 176, IMS-UAF

CITATION : Haflinger, K. 1978. A numerical analysis of the distribution of the benthic infauna of the southeastern Bering Sea shelf. Ms. Thesis, Univ. Alaska, Fairbanks. 139 pp.

KEY-WORDS: Benthos; Infauna; Invertebrates; Communities; Frontal zones.

SYNOPSIS : The continental shelf region of the southeastern Bering Sea may be classified into five provinces (station groups) based on infaunal distribution. Three large station groups lie in adjacent bands extending from the Alaskan coast to the shelf break, roughly paralleling bathymetry. Two small groups occupying positions at the head of Bristol Bay and off Nunivak Island were identified. Stations in the northeastern section of the study area (near the Pribilof islands) show no strong affinity to the major station groups. Fourteen major biocoenoses identified on the basis of species distribution show strong correlation with the spatial positioning of station groups. Spatial patterning of these species groups is described on the basis of their representation at station groups. Characteristic differences in trophic structure between station groups are attributed to the effects of storm-induced turbulence in nearshore environments and periodic intensive input of organic carbon in the midshelf region.

ACCESS # : 177, IMS-UAF

CITATION : Wespestad V, G. and L.H. Barton. 1981. Distribution, migration, and status of Pacific herring. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 1: 509-525. NOAA, distrib. by Univ. Washington Press, Seattle, Wa.

KEY-WORDS: Distribution; Migration; Herring; Spawning; Fecundity.

SYNOPSIS : Pacific herring are an important part of the Bering Sea food web and form the basis of a major commercial fishery. Most herring are harvested in coastal waters during the spawning period, which begins in late April/mid-May along the Alaska Peninsula and Bristol Bay and progressively later north. Sexual maturity begins at age two, but most herring mature at ages three and four, the ages of recruitment to the fishery. Three major stocks occur in the Bering Sea: northwest of the Pribilof Islands, the Gulf of Olyutorski, and Cape Navarin. Although assessment of eastern Bering Sea herring have ranged from 374 thousand mt to 2.75 million mt. the current estimate of spawning biomass is 432-864 thousand mt. Fisheries data indicate that herring declined rapidly after peak harvests in the early 1970's and that peak catches were supported by a few strong year classes. Weak year-classes occurred through the early 1970's and recruitment appears to be normalized in recent years.

ACCESS # : 178, ARL

CITATION : Lensink, C.J. and J.C. Bartonek. 1976. Seasonal distribution and abundance of marine birds: Part 1, shipboard surveys. Annual Reports of Principal investigators. Vol. 3: 107-64. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Seabirds; Distribution.

SYNOPSIS : A summary of marine bird observations collected on 21 cruises in Alaskan marine waters in 1975. Authors present information relating to regional and seasonal distribution and density by species. High densities are described for the nearshore Bristol Bay and Alaska Peninsula region for June through October, and for Unimak Pass at all seasons.

ACCESS #: 179, IMS-UAF

CITATION : Short, F. T., C.P. McRoy and W. Dennison. In Prep. Model simulation of nitrogen utilization, biomass, and production in a seagrass (*Zostera marina* L.) meadow. Unpubl. manuscript.

KEY-WORDS: *Zostera*; Izembek Lagoon; Simulation; Nitrogen; Eel grass.

SYNOPSIS : Data from a transect at Izembek Lagoon along a depth gradient are used to create a computer model. The model reasonably predicts changes in plant biomass and growth rates. The model predicts, from a nitrogen enrichment simulation, nitrogen and light limitation. Shallow water stations are generally limited by nitrogen depletion except in spring when light may be limiting. Deeper plants, in sediments of high organic content are limited by light during most of the year, with the possible exception of periods of rapid growth.

ACCESS # : 160, IMS-UAF

CITATION : Sharma, G.D. 1974. Contemporary depositional environment of the eastern Bering Sea. In: D.W. Hood and E.J. Kelley (eds.), Oceanography of the Bering Sea. Occ. Pub. No. 2. Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp. 517-552.

KEY-WORDS: Sediments; Volcanic ash; Ice/sediment relationship; Clay mineralogy; Heavy minerals.

SYNOPSIS : Deposition and transport of sediments in the Eastern Bering Sea is discussed in this paper. The water movement is the major control for the sediment transport and deposition in the eastern Bering Sea.

ACCESS # : 181, IMS-UAF

CITATION : Nelson, C.H., D.M. Hopkins, and D.W. Scholl. 1974. Cenozoic sedimentary and tectonic history of the Bering Sea. In: D.W. Hood and E.J. Kelley (eds.), Oceanography of the Bering Sea. Occ. Pub. No. 2. Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp. 485-516.

KEY-WORDS: Sediments; Tectonic history; River diversions; Submarine canyons; Abyssal basins.

SYNOPSIS : The Bering Sea consists of an abyssal basin that became isolated from the Pacific Ocean by the development of the Aleutian Ridge near the end of Cretaceous time and by formation of a large epicontinental shelf area that first became submerged near the middle of the Tertiary Period. We postulate that the sediment eroded from Alaska and from Siberia during Cenozoic time has been trapped in subsiding basins on the Bering shelf and abyssal basins during the Tertiary, collected in continental rise and abyssal plain deposits of the Bering Sea during Pleistocene periods of low sea level, and has been transported generally northward from the Bering shelf through the Bering Strait into the Arctic Ocean during periods of high sea level in the Pleistocene and Holocene. Filling of subsiding basins on the shelf was dominated by continental sedimentation on the early Tertiary and by marine deposition in the later Tertiary. River diversions caused by Miocene uplift of the Alaska Range increased the drainage area of the Yukon River two-fold or more. This change established the Yukon as the dominant source of river sediments (90 percent) reaching the Bering Sea and greatly accelerated sedimentation in the basins.

ACCESS # : 182, ADF&G

CITATION : Seaman, G.A., L.F. Lowry, and K.J. Frost. 1982. Foods of belukha whales (*Delphinapterus leucas*) in western Alaska. *Cetology* 44: 1-19.

KEY-WORDS: Beluga whale; Feeding; Trophic interactions; Marine mammals.

SYNOPSIS : Based on stomach observations from whales landed by subsistence hunters along the Bering and Chukchi coast, authors conclude that belugas feed on a wide variety of finfish, with diet primarily related to seasonal and areal distribution and abundance. During autumn and winter months pollock are probably the major prey in the southeastern and southcentral Bering Sea, while arctic and saffron cod are probably more important further north.

ACCESS # : 183, IMS-UAF

CITATION : Rugh, D. 1981. Fall gray whale census at Unimak Pass, Alaska, 1977-79. Abstr., 4th Biennial Conf. Biol. Mar. Mammals, 14-18 Dec., 1981, San Francisco.

KEY-WORDS: Gray whale; Population; Migration; Marine mammals.

SYNOPSIS : Author concludes that almost the entire population of gray whales migrates through Unimak Pass between late October to early January, most within 1.4 km of shore. The population summering in the Bering and Chukchi Seas is estimated at 17,000.

ACCESS #: 184, RAS-UAF

CITATION : Ridgway, S.H., and R.J. Harrison (eds.), . 1981. Handbook of marine mammals, Vol. 1 and 2. Academic Press, London and New York. 235 and 359 pp.

KEY-WORDS: Marine mammals; Biology; Distribution; Population; Ecology.

SYNOPSIS : Current information on taxonomy, anatomy, distribution, life history, behavior, food, reproduction, and mortality are included for 23 species of pinnipeds, including the 8 that occur in the Bering Sea.

ACCESS # : 185, IMS-UAF

CITATION : King, J.G., and C.P. Dau. 1981. Waterfowl and their habits in the eastern Bering Sea. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 2: 739-753. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Waterfowl; Ducks; Geese; Migration; Nesting.

SYNOPSIS : The authors discuss in this paper the various habitat types present along the coast of the eastern Bering Sea with estimates of the extent of each type of habitat within geographic regions. A general description of migration patterns and nesting habits is reviewed, and species accounts are given for major species, which includes migration routes and dates, and preferred foraging and nesting habitat. Bristol Bay is described as primarily staging habitat during migration with the largest concentration of nesting geese in America occurring to the north on the Yukon-Kuskokwim Delta.

ACCESS # : 186, IMS-UAF

CITATION : Gill, R.E., Jr., and C.M. Handel. 1981. Shorebirds of the eastern Bering Sea. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 2: 719-738. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Shorebirds; Migration; Habitat; Oil; Distribution.

SYNOPSIS : This paper describes and discusses the distributions and migratory habits of shorebird species utilizing the eastern Bering Sea. A general account of migration and habitat utilization is presented, followed by accounts by individual species. This region is used by 30 species of shorebirds, and is considered by the authors to be the most extensive and diverse expanse of intertidal habitat on the American coast of the Pacific. The intertidal of the Alaska Peninsula and Bristol Bay is used by migrating species in the spring as forage grounds in route to their breeding grounds. During the nesting period of late May through June there is little use of the littoral by shorebirds. After breeding, large numbers move back to the intertidal to feed, particularly in the Yukon Delta region. Though the lagoons of the Alaska Peninsula are important foraging habitat during this period, the extensive intertidal of northern Bristol Bay is little utilized for unknown reasons. A build-up of Western Sandpipers occurs in the Bristol Bay region in July and August, followed by an even larger buildup of Dunlin in September. The fall migration lasts into October for some species. Species are also ranked according to oil spill susceptibility. Within the Bristol Bay area, Western Sandpipers and Dunlin are considered particularly vulnerable.

ACCESS # : 187, IMS-UAF

CITATION : Hunt, G.L., Jr., P.J.Gould, K.J.Forsell, and H. Peterson, Jr. 1981. Pelagic distribution of marine birds in the eastern Bering Sea. In: D.W.Hood and J.A.Calder(eds.), The Eastern Bering Sea Shelf: Oceanography and Resources Vol. 2: 669-718. NOAA, distrib.by Univ.Washington Press, Seattle, W A.

KEY-WORDS: Seabirds; Distribution; Habitat.

SYNOPSIS : This chapter presents, by species, the seasonal and spatial distributions of seabirds over the eastern Bering Sea, with discussions of nesting habitat, locations of rookeries, diet, and population size. Distributional patterns, according to the authors, are the result of complex interactions between biotic and abiotic factors, including sea ice, food availability, habitat availability, and oceanographic frontal systems. Murres seem to be the most common bird on the eastern Bering during winter and spring, with Shearwaters the most common summer bird. They believe that previous estimates of marine bird populations of the region are unduly conservative, and that at least 40 million seabirds occupy the region, comprised by 45 species.

ACCESS # : 188, IMS-UAF

CITATION : Hunt, G.L., Jr., Z. Eppley, and W.H.Drury. 1981. Breeding distribution and reproductive biology of marine birds on the eastern Bering Sea. In: D.W. Hood and J.A.Calder(eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 2: 645-687. NOAA, distrib. by Univ. Washington Press Seattle, WA.

KEY-WORDS: Seabirds; Distribution; Breeding ecology; Ecology.

SYNOPSIS : In this paper the authors give the locations and population estimates for all seabird colonies of the eastern Bering Sea and discuss, by species, breeding behavior, reproductive success, productivity, and stability. In general, most of the breeding marine birds of the eastern Bering Sea are concentrated in a few large colonies. Cliff-nesting species seem to be habitat limited, while non cliff-nesters are more likely limited by availability of food resources. The level of productivity of various species and colonies, and the stability of productivity, seems to depend primarily on the stability and diversity of food utilized. This is often, in turn, related to weather. In the north Bering Sea, diving birds (alcids) seem to maintain relatively stable levels of productivity by comparison with surface feeders such as kittiwakes, which undergo wide fluctuations in response to variable food supplies.

ACCESS # : 189, IMS-UAF

CITATION : Hunt, G.L., Jr., B. Bergeson, and G.A.Sanger. 1981. Feeding ecology of seabirds of the eastern Bering Sea. In: D.W. Hood and J.A.Calder(eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol.2:629-647.NOAA, distrib.by Univ.Washington Press, Seattle, WA.

KEY-WORDS: Seabirds; Feeding ecology; Trophic interactions.

SYNOPSIS : A discussion, based on analyses of stomach samples, of the diet and feeding habits of major seabird species of the eastern Bering Sea. Composition of prey items are presented by species, area, and season. Authors conclude that, within a given area, only a very few prey species make up the bulk of foods consumed by seabirds, though prey items vary seasonally and from area to area. The total food consumption of seabirds in the eastern Bering Sea is estimated to be between 580,000 and 1,150,000 metric tons per year, including about 50% the tonnage of walleye pollock taken, in the form of adult fish, by commercial fisheries each year.

ACCESS #: 190, USF&WS

CITATION : Straty, R.I?., and R.E.Haight. 1979. Interactions among marine birds and commercial fish in the eastern Bering Sea. USF&WS Res. Rep. 11: 201- 219.

KEY-WORDS: Seabirds; Trophic interactions; Feeding; Fisheries management.

SYNOPSIS : A discussion of the interactions of marine birds and commercial fish species of the eastern Bering Sea, with recommendations for further research.

ACCESS # : 191, IMS-UAF

CITATION : Sanger, G.A. 1972. Preliminary ~~standing~~ stock and biomass estimates of seabirds ~~on~~ the subarctic Pacific ~~region~~. In: A.Y. Takenouti (ed.), Biological Oceanography of the Northern Pacific Ocean. Idemitsu Shoten, Tokyo, pp. 581-611.

KEY-WORDS: Seabirds; Abundance; ~~Distribution~~; Trophic dynamics; Ecology.

SYNOPSIS : Based on shipboard observations, the standing stock and biomass of marine birds are calculated and summarized by season and region for each ecological group. Annual food consumption and nutrient transfer are estimated, and a hypothetical food chain is discussed.

ACCESS # : 192, RAS-UAF

CITATION : Ogi, H., and T. Tsujita. 1973. Preliminary examination of stomach contents of murre (Uris spp.) from the eastern Bering Sea and Bristol Bay, June-August, 1970 and 1971. Jap. J. Ecol. 23: 201-209.

KEY-WORDS: Murres; Seabirds; Feeding; Fishes; Plankton.

SYNOPSIS : Based on examination of 163 stomachs, authors describe principal food as consisting of larval and juvenile fishes (pollock, sandlance, capelin, sockeye salmon), euphausiids, amphipods, and squid.

ACCESS # : 1S'3, RAS-UAF

CITATION : Lensink, C. J., J.C.Bartonek, and G.A.Sanger.1976. Feeding ecology and trophic relationships of Alaskan marine birds. Annual Reports of Principal Investigators. Vol.4.pp.321-344. OCSEAP/NOAA, Boulder, CO,

KEY-WORDS: Seabirds; Feeding; Ecology;Trophicinteractions.

SYNOPSIS : A presentation of data from preliminary analyses of 83stomachs collected from 14 species of seabirds. Frey items are described, for each species, in terms of frequency of occurrence and weight. Data are primarily from beyond thecontinental shelf in the Bering Sea.

ACCESS # : 194, RAS-UAF

CITATION : Lensink, C.J., J.C.Bartonek, and C.S. Harrison. 1976. Seasonal distribution and abundance of marine birds: Part 2, aerial surveys. Annual Reports of Principal Investigators. Vol. 4. pp. 1-98. OCSEAP/NOAA, "Boulder, co.

KEY-WORDS: Seabirds; Distribution.

SYNOPSIS : Asummaryof marine bird census data from 11 offshore aerial surveys conducted in 1972, 1973, and 1975. Distributional data are presented by species, region, and season. Inshore Bristol Bay is described as probable key winter habitat for Oldsquaws, and key spring habitat for Short-tailed Shearwaters.

ACCESS #: 195, RAS-UAF

CITATION : Lensink, C.J., and J.C.Bartonek. 1976. Population dynamics of marine birds. Annual Reports of Principal Investigators. Vol. 4. pp. 345-361. OCSEAP/NOAA, Boulder, CO.

KEY-WORDS: Seabirds; Population dynamics; Distribution.

SYNOPSIS : A review of existing information on marine bird distribution with research results from 1975 and 1976.

ACCESS # : 196, RAS-UAF

CITATION : Hunt, G., Z. Eppley, and W. Drury. 1979. Breeding distribution and reproductive biology of marine birds of the eastern Bering Sea. Pacific Seabird Group Bull. 6(2): 40. (abstract)

KEY-WORDS: Seabirds; Breeding distribution; Colony size; Productivity; Stability; Trophic interactions.

SYNOPSIS : A summary of available data pertaining to distribution and breeding biology of seabirds of the region with broad conclusions concerning distributions, colony size, and productivity and stability of populations. Authors postulate cliff-nesting species are habitat limited, while other species are primarily food limited. Differences in productivity and stability between colonies is related to food availability, reliability, and diversity.

ACCESS # : 197, RAS-UAF

CITATION : Harrison, C.S. 1977. Aerial surveys of marine birds. Annual Reports of Principal Investigators. Vol. 3. pp. 285-593. OCSEAP/NOAA, Boulder, CO.

KEY-WORDS: Seabirds; Distribution; Abundance.

SYNOPSIS : Report analyzes results of aerial surveys between January and October, 1976. Distribution and abundance data are presented by species and region for the Beaufort, Chukchi, and Bering Seas, and areas of probable critical habitat are assessed.

ACCESS # : 198, RAS-UAF

CITATION : Divoky, G.J., and A.E. Good. 1979. The distribution, abundance and feeding ecology of birds associated with pack ice. Annual Reports for Principal investigators. Vol. 1. pp. 330-599. OCSEAP/NOAA, Boulder, CO.

KEY-WORDS: Seabirds; Sea ice; Distribution; Abundance; Ecology.

SYNOPSIS : Pelagic distribution and abundance are mapped by species for the Beaufort Sea, Chukchi and Bering Seas based on results of marine surveys. Densities are analyzed in relation to distance from land. Seasonal habitat use is also described from ground surveys at 12 coastal sites. Study deals primarily with the Beaufort and Chukchi Seas.

ACCESS # : 199, IMS-UAF

CITATION : Sowls, A.L., S.A. Hatch, and C.J. Lensink. 1978. Catalog of Alaskan seabird colonies. USF&WS Biol Serv. Prog. Anchorage, Ak. 32 pp. + atlas.

KEY-WORDS: Seabirds; Colonies; Distribution; Abundance.

SYNOPSIS : A brief narrative description of the distribution, biology, and population status of seabird species common to Alaskan waters. The accompanying atlas illustrates the location of all known seabird colonies in Alaska with estimates of the number of birds of each species at each colony.

ACCESS # : 200, ARL

CITATION : Sanger, G.A., and P.A. Baird, 1977. Aspects of the feeding ecology of Bering Sea avifauna. Annual Reports of Principal Investigators. Vol. 12. pp. 372-417. OCSEAP/NOAA, Boulder, CO.

KEY-WORDS: Seabirds; Feeding ecology; Trophic Interactions.

SYNOPSIS : A review of published and unpublished information pertinent to the feeding ecology of Bering Sea birds, with a discussion of possible commercial fisheries/seabird interactions. Shearwaters and murre are described as eating large quantities of schooling pelagic and demersal fish, and euphausiids. Shearwaters (mostly short-tailed) are described as the most abundant bird in the Bristol Bay area in summer, but are absent in winter. Locations are noted for known nesting colonies of murre, Black-legged Kittiwakes, and Parakeet Auklets.

ACCESS # : 201, ARL

CITATION : Sanger, G.A., and P.A. Baird. 1977. The trophic relationships of marine birds on the Gulf of Alaska and the southern Bering Sea. Annual Report of Principal Investigators for 1976/1977. Vol. 4. pp. 694-757. OCSEAP/NOAA, Boulder, CO.

KEY-WORDS: Seabirds; Trophic interactions; Ecology.

SYNOPSIS : In this report the authors present' results of analyses of seabird stomachs from the Gulf of Alaska and the southern Bering Sea. Data indicate that, though there is considerable overlap, closely related species in the same area pursue slightly different feeding strategies. Sooty Shearwaters, for instance, feed primarily on fish and secondarily on squid, while the reverse is true for Short-tailed Shearwaters. Common Murres feed almost exclusively in fish, while Thick-billed Murres feed predominately on squid. General dietary composition of 14 major species is presented, and total populations are estimated.

ACCESS # : 202, RAS-UAF

CITATION : Rice, D.W., and A.A. Wolman. 1971. The life history and ecology of the gray whale (Eschrichtius robustus). Am. Soc. Mammal. Spec. Publ. NO. 3. 142 pp*

KEY-WORDS: Gray whale; Biology; Feeding; Population dynamics; Marine mammals.

SYNOPSIS : A comprehensive review of available information relating to gray whale population status, migration, age structure, growth, reproduction, predators, exploitation, and feeding habits. In the Bering and Chukchi Seas, at least 17 species of gammarid amphipods are consumed, especially Ampelisca macrocephala.

ACCESS # : 203, ARL

CITATION : Reilly, S., D. Rice, and A. Wolman. 1980. Preliminary population estimate for the California gray whale based upon Monterey shore censuses, 1967/68 to 1978/79. Rep. Int. Whaling Comm. 30: 359-368.

KEY-WORDS: Gray whale; Population; Marine mammals.

SYNOPSIS : Based on shore counts over the past 12 years, the current population estimate for the gray whale is 16,500 plus or minus 2,900 animals, virtually all of which summer in the Bering and Chukchi Seas.

ACCESS # : 204, RAS-UAF

CITATION : McAllister, W.B., and M.A. Perez. 1976. Ecosystem dynamics of birds and marine mammals, Part 1: Preliminary estimates of pinniped-fish relationships in the Bering Sea. Proc. Rep. RU-77. 29 pp. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Marine mammals; Fish; Feeding; Trophic Interactions.

SYNOPSIS : Based on available data concerning populations, residence times, and average consumption rates, estimates are derived by season and area of finfish consumption by major pinniped species. For the eastern Bering Sea shelf, annual total consumption is estimated at 4,223 metric tons, including 2,117 metric tons of finfish. This is equivalent to or slightly in excess of the present commercial take, though different species may be impacted.

ACCESS # : 205, RAS-UAF

CITATION : Harrison, C.S., and J.D. Hall. 1978. Alaskan distribution of the beluga whale, *Delphinapterus leucas*. Can. Field Nat. 92:235-241.

KEY-WORDS: Beluga whale; Population; Distribution; Marine mammals.

SYNOPSIS : Based on extensive aerial surveys, the authors describe observed distribution and abundance patterns of belugas in Alaskan coastal waters.

ACCESS #: 206, RAS-UAF

CITATION : Gurevich, V.S. 1980. Worldwide distribution and migration patterns of the white whale (beluga), *Delphinapterus leucas*. Rep. Int. Whaling Comm. 30: 465-480.

. KEY-WORDS: Beluga whale; Feeding; Abundance; Biology; Marine mammals; Fishes.

SYNOPSIS : An extensive review of information on belugas, including geographical races, behavior, herd structure, habitat, food, migration, and abundance. In the North Pacific, foods eaten include salmonids, herring, flatfish, navaga, and smelt.

ACCESS #: 207, ADF&G

CITATION : Fried, S.M., J.J. Laner, and S.C. Weston. 1979. Investigation of white whale (*Delphinapterus leucas*) predation upon sockeye salmon (*Oncorhynchus nerka*) smelts in Nushagak Bay and associated rivers: 1979 aerial reconnaissance surveys. Unpub. Rep., ADF&G, Dillingham. 15 pp.

KEY-WORDS: Beluga whale; Salmon; Feeding; Fisheries; Marine mammals.

SYNOPSIS : During aerial surveys, a total of 280 beluga were seen during flood tide, mostly moving upriver. No correlation was drawn between number of belugas seen and seaward movements of salmon smelts.

ACCESS # : 208, RAS-UAF

CITATION : Fiscus, C.H., and G.A. Baines. 1966. Food and feeding behavior of Steller and California sea lions. J. Mammal. 47: 195-200.

KEY-WORDS: Sea lions; Feeding; Trophic dynamics; Marine mammals; Fishes.

SYNOPSIS : From examinations of 34 Steller sea lion stomachs, authors conclude that predation on commercial fish species is probably minimal. Major prey items included capelin, sand lance, rockfish, sculpins, and flatfish. Only one had fed on salmon.

ACCESS #: 209, RAS-UAF

CITATION : Fiscus, C. H. 1980. Marine mammal-salmonid interactions: a review, in: McNeil, W.J., and D.C. Himsworth(eds.). Salmonid ecosystems of the North Pacific. Oregon State Univ., Corvallis. pp. 121-132.

KEY-WORDS: Marine mammals; Fisheries; Salmon.

SYNOPSIS : From an assessment of available information, the authors conclude that, although 8 species of marine mammals of the Bering Sea feed in salmon to some degree, only beluga whales consistently consume significant numbers of mature fish.

ACCESS # : 210, RAS-UAF

CITATION : FAO. 1978. Mammals in the Seas. Rep. of the FAO Advisory Comm. on Mar. Resources Research; working party on marine mammals. FAO Fish. Ser. 5.1: 1-275.

KEY-WORDS: Marine mammals; Populations; Distribution; Biology; Ecology.

SYNOPSIS : This book includes chapters on species distributions, population status, ecological relationships, human interactions, and biology. Eight area case studies are described, including the Bering Sea.

ACCESS # : 211, UW

CITATION : Favorite, F., T.Laevastu, and R.R.Straty. 1977. Oceanography of the northeastern Pacific Ocean and eastern Bering Sea, and relations to various living marine resources. U.S. Dept. Comm. NOAA/NMSF. NW&Ak. Fish. Cent. Process Rep. 280 pp.

KEY-WORDS: Salmon; Oceanography; Ecology; Fisheries management.

SYNOPSIS : This report relates faunal population distributions to physical parameters such as temperature and salinity. In regard to Bristol Bay salmon resources, the authors describe the timing and migration routes of juvenile and adult sockeye salmon and relate such events and patterns to salinity and temperature distributions. The results and conclusions are essentially the same as those described above for the report by Straty and Jaenicke, 1980.

ACCESS # : 212, RAS-UAF

CITATION : Ogi, H. 1973. Ecological Studies on juvenile sockeye salmon, Oncorhynchus nerka (Walbaum) in Bristol Bay with special reference to its distribution and population. Hokkaido Univ. Bull. Fac. Fish. 24: 14-41.

KEY-WORDS: Distribution; Temperature; Salinity; Population; Salmon.

SYNOPSIS : An assessment of the distribution of juvenile sockeye salmon in Bristol Bay in relation to temperature and salinity, based on trawl samples taken during the summers of 1969 and 1970, is given here. The author also discusses distribution by age group and size within Bristol Bay.

ACCESS # : 213, RAS-UAF

CITATION : Straty, R.R., and H.W. Jaenicke. 1980. Estuarine influence of salinity, temperature, and food on the behavior, growth, and dynamics of Bristol Bay sockeye salmon. In: McNeil, W.J., and D.C. Himsworth (eds.). Salmonid Ecosystems of the North Pacific. Oregon State Univ. Press. Corvallis, OR. 331 pp.

KEY-WORDS: Salmon; Salmon Ids; Population dynamics; Fisheries management; Ecosystem analysis.

SYNOPSIS : A comprehensive assessment of the timing and migratory routes of adult and juvenile sockeye salmon in Bristol Bay, with evaluation of environmental factors (temperature, salinity, and food) on growth and migration is presented here. Sockeye smelt begin their seaward migration around the middle of May, reach Bristol Bay by the middle of July, and reach the North Pacific about six months later. This seaward migration remains nearshore, in the upper 10 meters of the water column, until it reaches the Port Moller area, after which it swings offshore and out to sea. The migration route appears to be in response to salinity gradients, with the speed of the migration at least partly determined by near-surface water temperatures. The food of juveniles consists primarily of zooplankton and *smaller* fishes. The adults return to Bristol Bay in mid-June and early July, entering the river systems by late July or early August. Cannibalism of the young does not occur, because the adults stay well out to sea until they reach the vicinity of their home rivers.

ACCESS # : 214, ADF&G

CITATION : Munday, P.R. 1977. Bristol Bay Data Base. Contract Rep. #3253, ADF&G, Anchorage, AK.

KEY-WORDS: Escapement; Salmon; Fisheries.

SYNOPSIS : This is a presentation of historical data, by year and statistical area of escapement, catch, and total run estimates for Bristol Bay salmon fisheries.

ACCESS # : 215, UW

CITATION : Harris, C.K., and D.E. Rogers. 1978. Forecast of the sockeye salmon run to Bristol Bay in 1978. University of Washington. Fish. Res. Inst. Circular No. 78-1.

KEY-WORDS: Salmon; Bristol Bay; Fisheries management; Forecast

SYNOPSIS : This report predicts the sockeye salmon run to major fishing districts within Bristol Bay (Naknek-Kvichak, Egegik, Nushagak) for 1978 and compares this forecast with previous runs (1950 through 1977).

ACCESS # : 216, ARL

CITATION : Stern, L.J., D.E. Rogers, and A.C. Hartt. 1976. Determination and description of knowledge of the distribution, abundance, and timing of salmonids in the Gulf of Alaska and Bering Sea. Final Report of Principal Investigators. Vol. 2, pp. 691-748. OCSEAP/NOAA, Boulder, CO.

KEY-WORDS: Salmon; Bristol Bay; Fisheries Management; Population dynamics
Population ecology.

SYNOPSIS : A comprehensive *review* and synthesis of available data pertaining to the salmon fishery of the southeastern Bering Sea are presented. Authors present historical data back to 1925 with catch, escapement, and population estimates and means for each species by statistical area. Information is presented relative to timing of spawning runs of various species and to timing of downstream smelt migrations. Migration pathways of juveniles and spawning adults is also discussed, and nursery streams are delineated for each of the species occurring in the Bristol Bay-Alaska Peninsula area. Historically, inner Bristol Bay has been the most important salmon fishery in North America, with an average annual catch of over 10 million fish. The total Bristol Bay spawning run averages 18.3 million fish, ranging as high as 32.4 million. Sockeye salmon comprise 86% of the catch, followed by pinks and chum. About 80% of the Bristol Bay catch comes from Kvichak and Nushagak Bays.

ACCESS # : 217, ADF&G

CITATION : Frost, K.J., L.F. Lowry, and J.J. Burns. 1982. Distribution of marine mammals in the coastal zone of the Bering Sea during summer and autumn. OCSEAP/NOAA. RU# 613. OCSEAP Contract Report #NA 81 RAC 000 50. 188 pp.

KEY-WORDS: Marine mammals; Distribution; Coastal zone.

SYNOPSIS : A compilation of available sighting and information of marine mammal distributions and hauling areas in the coastal zone of the Bering Sea during ice-free months is presented here. Hauling areas and rookeries are delineated for Steller sea lions, harbor seals, spotted seals, and walrus.

2

ACCESS #: 218, IMS-UAF

CITATION : Harry, G.Y., and J.R. Hartley. 1981. Northern fur seals in the Bering Sea. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 2: 847-867. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Fur seals; Trophic dynamics; Population dynamics; Marine mammals; Fisheries.

SYNOPSIS : An account of the history of fur sealing and the fur seal population is given, with discussion of present population status, seasonal/spatial distribution, food preference and metabolic requirements, mortality, and competition/interaction with other marine mammals and commercial fisheries.

ACCESS #: 219, IMS-UAF

CITATION : Frost, K.J., and L.F. Lowry. 1981. Foods and trophic relationships of cetaceans in the Bering Sea. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 2. pp. 825-836. NOAA, distrib. by Univ. Washington Press. Seattle, Washington.

KEY-WORDS: Cetaceans; Whales; Trophic dynamics; Ecology; Marine mammals.

SYNOPSIS : Authors present available information on the food habits of 13 cetacean species in the Bering Sea. With exception of gray whales, which are benthic feeders, all cetaceans are supported by a pelagic food web and all compete to some degree among themselves and with fishes, pinnipeds, seabirds, and humans.

ACCESS # : 220, NPFMC

CITATION : Lowry, L.F., K.J. Frost, D.G. Calkins, G.L. Swartzman, and S. Hills. 1982. Feeding habits, food requirements, and status of Bering Sea marine mammals. N. Pac. Fish. Manag. Coun. Dec. No. 19, 291 pp. plus annotated bibliography.

KEY-WORDS: Marine mammals; Trophic dynamics; Population dynamics; Fisheries management.

SYNOPSIS : This report is a compilation, summary and evaluation of all currently available data and information concerning population status, seasonal and spatial distribution, feeding habits and food requirements of 26 species of marine mammals occurring in the Bering Sea and Aleutian Islands region, with particular attention to possible interactions with and impact on commercial fisheries of the area. A high probability of such interactions is suggested for northern fur seal, Steller sea lion, harbor seal, spotted seal, beluga whale, harbor porpoise, sea otter, gray whale, walrus, Dall's porpoise, ribbon seal, and bearded seal. Predictive assessments of interactions based on ecosystems models and simulations are not presently possible.

ACCESS # : 221, ARL

CITATION : Fay, F.H. 1982. Ecology and biology of the Pacific Walrus, *Odobenus rosmarus divergens* (Illiger). U.S.F. & W.S., N. Amer. Fauna. No. 74, 279 pp.

KEY-WORDS: Walrus; Ecology; Marine mammals.

SYNOPSIS : A thorough and comprehensive account of present and historical walrus population, seasonal and spatial distribution patterns, migration patterns, behavior, diseases, mortality, reproduction, taxonomy, feeding behavior, and general biology is presented.

ACCESS # : 222, RAS-UAF

CITATION : Fay, F.H. 1981. Belukha Whale. In: pp. 133-137, D.Haley (ed.), *Marine Mammals of Eastern North Pacific and Arctic Waters*. Pacific Search Press.

KEY-WORDS: Beluga Whale; Trophic dynamics; Marine mammals; Fishes.

SYNOPSIS : The food of beluga whales includes some 100 kinds of marine organisms, including small schooling fish, squid, octopuses, crabs, shrimp, snails, and worms. Fishes such as capelin, cod, herring, smelt, and flounder make up most of the diet in spring, summer, and autumn; polar cod is the main winter food,

ACCESS # : 223, ARL

CITATION : Laevastu, T., P. Livingston, and K. Niggol. 1980. Marine mammals in fisheries ecosystem in the eastern Bering Sea and in the northeastern Pacific Ocean. Part.1: Inputs of marine mammal data for ecosystem models PRUBUB 80-1 and 80-2, U.S. Dept. Comm. NOAA/NMFS, NW&Ak. Fish, Cent. Proc. Rep. 80-9, 13 pp.

KEY-WORDS: Marine mammals; Trophic dynamics; Fisheries management.

SYNOPSIS : Authors summarize population and distribution information concerning all marine mammal species of the area, discuss food preferences of the various species, and estimate total consumption of commercial species by marine mammals.

ACCESS # : 224, RAS-UAF

CITATION : Everitt, R.D., and H.W. Braham. 1980. Aerial Survey of Pacific harbor seals in the southeastern Bering Sea. Northwest Science 54(4): 281-288.

KEY-WORDS: Harbor Seal; Population dynamics; Population distribution; Marine mammals.

SYNOPSIS : Based on 5 aerial surveys conducted between June, 1975 and June, 1977 along the eastern Aleutians and throughout Bristol Bay, a minimum number of 29,000 harbor seals was estimated for the area. Three locations on the north side of the Alaska Peninsula - Port Moller, Port Heiden, and Cinder River accounted for 78% of the study area population count.

ACCESS # : 225, RAS-UAF

CITATION : Rugh, D.J., and H.W.Braham. 1979. California Gray Whale (Eschrichtius robustus) fall migration through Unimak Pass, Alaska. 1979. Rep. Int. Whaling Comm. 29, 20 pp.

KEY-WORDS: Gray Whale; Migration; Marine mammals.

SYNOPSIS : Based on shore observations from Cape Sarichef, Unimak Island, from 20 November to 9 December, 1977, authors estimate that approximately 15,099 +/- 2,341 gray whales left the Bering Sea via Unimak Pass.

ACCESS # : 226, RAS-UAF

CITATION : Hall, J.D., C.S.Harrison, J. Nelson, and A. Taber. 1977. The Migration of California Gray Whales into the Bering Sea. IN: Proc.(abstracts), Second Conf.Biol. Mar. Mammals, San Diego, CA., 12-15 December 1977. 8 pp.

KEY-WORDS: Migration; Marine mammals; Gray Whale.

SYNOPSIS : Shore observations from Cape Sarichef(Unimak island) during the spring of 1977 indicate that approximately 9,000 gray whales entered the Bering Sea via Unimak Pass between 7 April and 26 May, 1977.

ACCESS # : 227, RAS-UAF

CITATION : Everitt, R.D. and B.D. Krogman. 1979. Harbor seal distribution and abundance in the Bering Sea: Alaska Peninsula and Fox Islands. Science in Alaska, Proc. 29th Alaska Sci. Conf., Fairbanks, Ak. 21 pp.

KEY-WORDS: Harbor seal; Population dynamics; Marine mammals.

SYNOPSIS : Estimates of harbor seal populations in Bristol Bay, along the north side of the Alaska Peninsula, and in the eastern Aleutians as far west as Samalga Island, based on 6 aerial surveys between June, 1975, and July, 1976. A minimum estimate of 28,000 to 30,000 animals is arrived at for the area, with 80% of the population concentrated at 8 hauling areas along the north side of the Alaska Peninsula.

ACCESS #: 228, RAS-UAF

CITATION : Taylor, F.H.C., M. Fujinaga, and F. Wike. 1955. Distribution and food habits of the fur seals of the North Pacific Ocean. U.S. Dept. Inter., F&WS, Wash., D.C. 86 pp.

KEY-WORDS: Fur seals; Trophic dynamics; Marine mammals; Distribution; Population.

SYNOPSIS : Pelagic distribution of fur seals is discussed based on shipboard surveys, winter concentrations are noted, sex and age ratios noted, and results of stomach content analysis is presented by region.

ACCESS # : 229, RAS-UAF

CITATION : Lander, R.H. and H.Kajimura. 1978. Status of northern fur seals. In: Mammals in the seas. FAO Fish. Ser. No. 5., Vol. 2., 50 pp.

KEY-WORDS: Fur seals; Pribilof Islands; Population dynamics; Ecology; Marine mammal ls.

SYNOPSIS : Discusses current fur seal population, birth rates, mortality, harvesting, range, and feeding habits. The current Pribilof Islands population is estimated at 1,300,000. Principal prey items are capelin, pollock, mackerel, sand lance, and squid.

ACCESS # : 230, NW&AFC

CITATION : Kooyman, G.L., R.L. Gentry, and B.W. McAlister. 1976. Physiological impact of oil on pinnipeds. 23 pp. NOAA/NMFS. NWAFC, Marine Mammal Division, Seattle, WA.

KEY-WORDS: Marine mammals; Pinnipeds; Seals; Physiology; Oil pollution.

SYNOPSIS : Authors discuss the physiology effects of various types of oil on several species of pinnipeds. Results indicate that even small amounts of oil have very adverse effects on fur-bearing seals (sea lions and fur seals) but negligible effects on non fur-bearing (Phocid) seals.

ACCESS # : 231, RAS-UAF

CITATION : Kenyon, K.W. and D.W. Rice. 1961. Abundance and distribution of the Steller sea lion. J. Mammal. 42: 223-234.

KEY-WORDS: Sea lion; Population dynamics; Distribution; Marine mammals.

SYNOPSIS : Discusses population estimates and distribution of sea lions in the Bering Sea from Bering Strait to and including the Aleutian Islands. The author also presents information on seasonal movements, hauling and rooking locations, and hauling-out behavior.

ACCESS # : 232, RAS-UAF

CITATION : Lowry, L.F., K.J. Frost, and J.J. Burns. 1980. Feeding of bearded seals in the Bering and Chukchi Seas and trophic interaction with pacific walrus. Arctic 33(2): 330-342."

KEY-WORDS: Bearded seal; Walrus; Trophic dynamics; Marine mammals.

SYNOPSIS : Discusses feeding habits and prey preference of bearded seals and walrus, based on analysis of stomach samples, in the Bering and Chukchi Seas. Though the diets of the two species overlap in that both feed on clams when they are available, walrus are apparently very dependent on bivalves as the mainstay of their diet whereas bearded seals are more euryphagous and flexible. The walrus population appears to be exhibiting some signs of stress, possibly due to a recent population increase and predation pressure on these bivalve food resources. Bearded seals, on the other hand, show no indications of such stress.

ACCESS # : 233, ARL

CITATION : Lowry, L.F., K.J.Frost, and J.J. Burns. 1979. Trophic relationships among ice-inhabiting phocid seals. Principal Investigators' Reports for the Year Ending March 1977. Vol.1. pp. 303-390. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Marine mammals; Phocid seals; Trophic dynamics; Sea ice.

SYNOPSIS : Based primarily on stomach analysis of samples obtained from coastal seal-hunting subsistence villages, the food preferences of each species of seal is discussed by geographic area. Potential effects of petroleum development in the area are also discussed.

ACCESS # : 234, ADF&G

CITATION : Seaman, G.A. and J.J. Burns. 1981. Preliminary results of recent studies of belugas in Alaskan waters. Rep. Int. Whal. Comm. 31: 567-573

KEY-WORDS: Beluga whale; Ecology; Population dynamics; Subsistence; Marine mammals.

SYNOPSIS : Presents data on beluga subsistence harvest by Alaskan Natives, killed and lost ratios, reproductive biology, and feeding behavior.

ACCESS #: 235, ADF&G

CITATION : Klinkhart, E. 1966. The beluga whale in Alaska. ADF&G. Fed. Aid Wildl. Rest. Proj. Rep., Vol. 7. 11 pp.

KEY-WORDS: Beluga whale; Ecology; Population dynamics; Marine mammals.

SYNOPSIS : Presents general information on the population status, distribution and life history of belugas. The Bristol Bay population, considered to be resident year-round, is estimated at 1,000 to 1,500.

ACCESS #: 236, RAS-UAF

CITATION : Johnson, B.W. 1977. The effect of human disturbance on a population of harbor seals. Principal Investigators' Reports for the Year Ending March 1977. Vol. i. pp. 422-432, OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Harbor seal; Disturbance; Ecology; Marine mammals.

SYNOPSIS : Based on observations of harbor seals on Tugidak Island, the author describes effects of natural disturbance (eagles, rock slides) and human disturbance (low-flying aircraft, hikers, all-terrain vehicles) on a harbor seal rookery. It is estimated that human disturbance, particularly low-flying aircraft, caused more than 10% pup mortality.

ACCESS #: 237, IMS-UAF

CITATION : Sergeant, D.W., and P.F. Brodie. 1975. Identity, abundance and present status of populations of white whales, *Delphinapterus leucus*, in North America. J. Fish. Res. Bd. Can. 32: 1047-1054.

KEY-WORDS: Beluga whale; Population dynamics; Distribution; Marine mammals.

SYNOPSIS : Identifies and characterizes various geographic populations of belugas, presents size data by population and sex, and estimates abundance for each population. Evidence indicates that more southerly populations of beluga attain larger body size, which perhaps correlates to increased primary and secondary marine productivity in these areas. Authors propose that the southern limits of beluga range may be defined by competition with other delphinids or by predation by killer whales.

ACCESS # : 238, RAS-UAF

CITATION : U.S. Interagency Task Group. 1976. Draft environmental impact statement in consideration of a waiver of the moratorium and return of management of certain marine mammals to the state of Alaska. U.S. Dept. Comm. NOAA/NMFS. Wash., D.C.

KEY-WORDS: Marine mammals; Population dynamics; Sustainable yield; Game management.

SYNOPSIS : A presentation, based on best available data (as of 1976) of the population status, distribution, productivity, subsistence harvest level, and sustainable yield harvest level for 9 species of marine mammals occurring in Alaskan waters. For Bristol Bay, the Steller Sea lion population (1976) is estimated at 2,700 (excluding Unimak Island), with 6 known rookeries. The harbor seal population of Bristol Bay is estimated (conservatively) at 30,000, the beluga whale population at 1,500.

ACCESS # : 239, RAS-UAF

CITATION : Haley, D. (ed.). 1978. Marine Mammals of Eastern North Pacific and Arctic Waters, Pacific Search Press. Seattle, Wash. 256 pp.

KEY-WORDS: Marine mammals; Distribution; Biology.

SYNOPSIS : A compilation of works by 21 authors presenting current information on abundance, distribution, natural history, research methods, human impacts, and other facets of over 40 marine mammal species occurring in the area.

ACCESS # : 240, RAS-UAF

CITATION : Schneider, K., and J.B. Fare. 1975. Effects of sea ice on sea otters (*Enhydra lutris*). J. Mammal. 56(1): 91-101.

KEY-WORDS: Sea ice; Marine mammals; Sea otter.

SYNOPSIS : A discussion of the effects of ice on the otter population of southern Bristol Bay during the winters of 1971 and 1972. During the unusually extensive and sudden penetration of sea ice along the Alaska Peninsula in 1971, otter mortality *was* estimated to be at least 200. During 1972, when the onset of ice was less sudden, mortality appeared to be negligible. Authors also note the expansion of known otter range northeastward to Port Heiden by 1970.

ACCESS # : 241, RAS-UAF

CITATION : Schneider, K. 1976. Distribution and abundance of sea otters in southwestern Bristol Bay. Quarterly Report Ending December 1976. pp. 469-526. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Sea otter; Population dynamics; Marine mammals.

SYNOPSIS : A good account of the population status and distribution of otters in Bristol Bay as of 1976. Author estimates that the total population may be 8,000 to 10,000 animals based on what data was available at that time. High population densities are found from Cape Mordvinof (Unimak Island) to roughly 30 miles northeast of Izembek Lagoon, with lesser densities occurring northeast along the Alaska Peninsula to about Ugashik. In years of heavy and extensive winter sea ice, the population shifts to the southwest, often suffering significant mortality. Sea otters have been observed to range out to the 40 fathom isobath in Bristol Bay, as much as 30 miles offshore. They are estimated to consume approximately 20 to 25% of their body weight daily in food.

ACCESS # : 242, ADF&G

CITATION : Kosygin, G.M. 1976. Feeding of the bearded seal *Erignathus barbatus nauticus* (Pallas) in the Bering Sea during the spring-summer period. Fisheries and Marine Science Translation No. 3747. 14 pp. Dept. of the Environment, Fish. and Mar. Serv. Arctic Biol. Station. Ste. Anne de Bellevue, P.Q., Canada.

KEY-WORDS: Bearded seal; Marine mammals; Trophic dynamics,

SYNOPSIS : A description of bearded seal feeding behavior from analysis of 565 stomach samples collected over a three year period (1963-1965) is given. Items identified include 30 species of crustaceans, several species of mollusks, sponges, annelids, and 15 fish species. Primary prey species were *Chionoecetes opilio* (53-76% by weight), crangonid shrimps, panulid shrimps, *Hyas coarctatus*, octopods, and various species of fish.

ACCESS # : 243, NPFMC

CITATION : Fay, F.H., and L.F. Lowry. 1981. Seasonal use and feeding habits of walrus in the proposed Bristol Bay clam fishery area. Final Rep., N. Pac. Fish. Manag. Council. Contract No. 80-3.

KEY-WORDS: Walrus; Marine mammals; Distribution; Fisheries management; Trophic dynamics.

SYNOPSIS : An account of the population distribution, hauling areas, migration patterns, feeding behavior and food requirements of walrus within Bristol Bay. Total numbers of walrus censused ranged from 280 (Jan., 1981) to 63,800 (May, 1980). During years of extensive sea ice walrus are numerous in Bristol Bay in winter, with significantly lower populations during years of light sea ice. A resident population of about 20,000 animals, mostly males, resides in the area from May through August. The primary hauling ground is Round Island, though in recent years irregular haulouts have been observed on Amak Island, Walrus Island, Deer Island, Cape Seniavin, Cape Constantine, and Cape Newenham. At least 22 genera of benthic invertebrates are eaten by walrus within the area, though 90% of the diet is comprised by 5 genera of bivalve mollusks.

ACCESS # : 244, RAS-UAF

CITATION : Estes, J.A., and J.F. Palmisano. 1974. Sea otters: their role in structuring nearshore communities. Science 185: 1058-1060.

KEY-WORDS: Sea otter; Marine mammals; Community structure; Ecology; Trophic dynamics.

SYNOPSIS : A descriptive comparison of nearshore communities which support substantial populations of sea otters (Amchitka Island) and communities which do not (Shemya Island), is given. Results indicate that otter predation on grazers, especially sea urchins, leads to greatly increased macroalgal standing stocks and consequently altered habitat and community structure from intertidal to 60 m.

ACCESS # : 245, ARL

CITATION : Kenyon, K.W.. 1975. The Sea Otter in the Eastern Pacific Ocean. Dover Publications, Inc. New York, N.Y. 352 pp.

KEY-WORDS: Sea otter; Marine mammals; Distribution; Life history; Abundance; Trophic dynamics.

SYNOPSIS : A comprehensive account of the distribution, abundance, habitat, behavior, feeding, and life history of sea otters in the eastern Pacific Ocean and Bering Sea. As of 1965, the sea otter population of the Unimak-Amak Island vicinity was estimated at 3,856. The Port Moller vicinity appears to be the northeastern limit of the sea otter's range in the Bering Sea, probably due to adverse seasonal ice conditions further north.

ACCESS # : 246, ARL

CITATION : Dept. Interior, USF&WS, Bur. Sport Fish & Wildl. 1972. River basin studies. Southeast Alaska, Bristol Bay waterbird survey. USF&WS, Anchorage. 8 pp.

KEY-WORDS: Seabirds; Waterfowl; Avifauna; Migration; Distribution.

SYNOPSIS : Based on preliminary aerial surveys, this report presents data on bird densities and distributions along the Alaska Peninsula and within Bristol Bay. Bristol Bay is described as a crossroads for waterfowl coming from wintering areas as divergent as Japan and Mexico and headed for breeding grounds as far east as Melville Island in Northern Canada and as far west as the delta of the Lena River in Central Siberia. It is considered critical staging habitat, very vulnerable to petroleum development.

ACCESS # : 247, RAS-UAF

CITATION : Hunt, G.L. Jr., J. Kaiwi, and D. Schneider. 1982. Pelagic distribution of marine birds and analysis of encounter probability for the southeastern Bering Sea. Final Reports of Principal Investigators. Vol. 16. pp. 1-160. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Seabirds; Oil Spills; Species Distribution; Distribution.

SYNOPSIS : This report estimates spatial and temporal distributions of seabirds over the southeastern continental shelf of the Bering Sea, and assesses the vulnerability, temporally and spatially, of seabird populations to possible oil spills in the area. The Bering Strait, the Pribilof and St. Lawrence Island vicinities, the shelf-edge, and Bristol Bay inside the 50 m curve are all considered sensitive areas. Shearwaters predominate in inner Bristol Bay, particularly in summer.

ACCESS # : 248, ARL

CITATION : Schneider, D. 1982. Fronts and seabird aggregations in the southeastern Bering Sea. Mar. Ecol. Prog. Ser. 10: 101-103.

KEY-WORDS: Seabirds; Trophic Dynamics; Ecology; Oceanography.

SYNOPSIS : This paper presents evidence that oceanic fronts, with associated enhancement of biological activity at the primary and subsequent levels, probably play a significant role in the feeding strategy of marine birds of the Bering Sea. Results indicate that birds frequenting the outer front (at the shelf break) are primarily surface feeders (fulmars and petrels), while those utilizing the inner (50m) front were primarily subsurface feeders (Shearwaters and murre).

ACCESS # : 249, RAS-UAF

CITATION : Gill, R., M. Petersen, C. Handel, J. Nelson, A. DeGange, A. Fukuyama, and G. Sanger. 1978. Avifaunal assessment of Nelson Lagoon, Port Moller, and Herendeen Bay, Alaska 1977. U.S. Fish and Wildlife Service. Office of Biological Services, Coastal Ecosystems, Anchorage, AK., 131 pp.

KEY-WORDS: Waterfowl; Shorebirds; Avifauna; Nelson Lagoon; Port Moller; Herendeen Bay; Population dynamics; Habitat ecology; Alaska Peninsula.

SYNOPSIS : This report describes results of field efforts conducted between 18 April and 15 October, 1977 in the Nelson Lagoon vicinity. Authors present information on abundance, habitat selection, breeding success, molting, roosting, nesting, and foraging areas for major species. Arrival and departure dates of major species are described, and seasonal variation in populations assessed. In addition, migration strategies of Dunlin and Western Sandpipers are analyzed and an assessment made of Steller's Eider feeding habits within the areas. Study deals primarily with waterfowl and shorebirds. Authors caution that other lagoon systems of the Alaska Peninsula support somewhat different avifaunal communities, so that results from the Nelson Lagoon study should not be extrapolated to other locales.

ACCESS # : 250, ARL

CITATION : Livingston, P. 1980. Marine bird information synthesis. NWAFC, NMFS/NOAA Process. Rep., 25 pp.

KEY-WORDS: Seabirds; Distribution; Trophic dynamics; Ecology.

SYNOPSIS : This is a synthesis by subregions of the eastern Bering Sea and western Gulf of Alaska of available information concerning marine bird population densities, distributions, and feeding behavior and food resources. Information is also presented on seasonal population fluctuations, by subregion for various species. Though not as specific for the northeast Aleutian-Bristol Bay area, the report does provide general information as to species distribution, abundance, and feeding behavior.

ACCESS # : 251, NMFS

CITATION : Wespestad, V., R. Bakkala, and J. June. 1982. Current abundance of Pacific cod (*Gadus macrocephalus*) in the eastern Bering Sea and expected abundance in 1982-86. NOAA Technical Memorandum NMFSF/NWC-25, 26 pp.

KEY-WORDS: Pacific cod; Abundance; Population dynamics; Fisheries.

SYNOPSIS : Resource assessment surveys by the Northwest and Alaska Fisheries Center (NWAFC) have shown a substantial increase in abundance of Pacific cod in the eastern Bering Sea since 1977. This increase is primarily due to the emergence of the strong 1977 year-class. Because the life span of cod is relatively short and the current abundance of the population is mainly the result of a single year-class, stock abundance may soon return to lower levels. Abundance of cod population was projected through 1986 using a numeric population simulator so that the fishing industry can anticipate the future harvest potential of the resource. The simulation indicates that the contribution of the strong 1977 year-class will diminish substantially when it reaches age 7 in 1984. Catches will then be reduced to a more historical level.

ACCESS # : 252, ARL

CITATION : Waldron, K.D. and B.V. Vinter. 1978. Ichthyoplankton of the eastern Bering Sea. Final Reports of Principal Investigators. Vol. 1. pp. 236-237. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Ichthyoplankton; Walleye pollock; Spawning periods; Vertical distribution; Horizontal distribution.

SYNOPSIS : This study mainly focused on walleye pollock, although other ichthyoplankton were also examined. Data were collected with bongo and neuston nets between mid April and mid May 1977. Most of the eggs and larvae collected were pollock. The report concludes that no marked differences in distribution and abundance of pollock eggs and larvae occurred between 1976 and 1977.

ACCESS #: 253, IMS-UAF

CITATION : Takeuchi, I. 1962. On the distribution of zoeae larvae of king crab, *Paralithodes camtschatica*, in the southeastern Bering Sea in 1960. Bulletin of Hokkaido Regional Fisheries Research Laboratory 24: 163-170.

KEY-WORDS: Crabs; *Paralithodes camtschatica*; Plankton; Larvae; Distribution; Crustacea.

SYNOPSIS : In 1960, for the purpose of surveying the distribution of king crab zoeae in the free-swimming stage at the king crab fishing grounds in southeastern Bering Sea, a series of samplings as carried out using standard North Pacific plankton nets and fish larvae nets. Also, in parallel with this, the egg-carrying state of the female crabs caught in commercial nets was examined. This study was mainly carried out in the Black Hills - Port Moller area.

ACCESS # : 254, IMS-UAF

CITATION : Somerton, D.A. 1982. Effects of sea ice on the distribution and population fluctuations of *Chionoecetes opilio* in the eastern Bering Sea. IN: Proceedings of the International Symposium of the Genus *Chionoecetes*. Lowell Wakefield Fisheries Symposia Series, Alaska Sea Grant Rep. 82-10, pp. 157-172.

KEY-WORDS: Sea ice; *Chionoecetes*; Distribution; Phytoplankton bloom.

SYNOPSIS : Evidence is examined which suggests that, in the eastern Bering Sea, *Chionoecetes opilio* may synchronize the release of its larvae with a spring phytoplankton bloom which is initialized by sea ice. When this ice edge bloom does not occur, either because ice is not present or because other conditions are not appropriate for initiation of a bloom, larval survival decreases. The distribution of *C. opilio* is therefore limited by the maximum extent of sea ice in April when *C. opilio* larvae enter the plankton.

ACCESS # : 255, ARL

CITATION : Feder, H. M., K. Haflinger, M. Hoberg and J. McDonald. 1981. The infaunal invertebrates of the southeastern Bering Sea. Final Reports of Principal Investigators. Vol 9. pp. 257-670. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Infaunal distribution; Bivalves; Benthos; Sediment structure; Biomass; Pinkneck clam.

SYNOPSIS : This document contains (1) a quantitative inventory of dominant benthic infaunal species within and adjacent to identified oil-lease sites in the southeastern Bering Sea, (2) species assemblages on the basis of distribution and abundance of infaunal species on the southeastern Bering Sea shelf, and (3) a preliminary comparison of dominant species with selected physical and geological features. The distribution of eight dominant bivalve mollusks is presented with respect to sediment.

ACCESS # : 256, IMS-UAF

CITATION : K.E. Haflinger, and C.P. McRoy. 1983. Yellowfin sole (*Limanda aspera*) predation on three commercial crab species (*Chionoecetes opilio*, *C. bairdi*, and *Paralithodes camtschatica*) in the southeast Bering Sea. Unpublished report.

KEY-WORDS: Yellowfin sole; Tanner crab; King crab; Predation; Trophic interactions.

SYNOPSIS : This document examined yellowfin sole prey, in particular commercially important crabs, from two areas in the southeastern Bering Sea. The only crab taken by fish from the mid-shelf area was the Tanner crab *Chionoecetes opilio*. An extrapolation to the total number of first instar crab consumed by 682 fish in the mid-shelf area over the time period of September-November (90 days) was 23,700,000,000. A similar extrapolation of crab in the 10-13 mm size class was 18,500,000. No difference in crab consumption by size group of fish was apparent, while a difference was apparent for mean number of crab between different sampling locations. Other important prey items in fish from the mid-shelf area were the polychaete *Myriocheles* sp., the bivalve *Clinocardium ciliatum*, and the holothuroid *Cucumaria calcigera*. Yellowfin sole (n=557) from the Alaska Peninsula region contained king crab (*Paralithodes camtschatica*) and Tanner crab (*C. bairdi*), but only two fish accounted for nearly all of the consumption reported here. The overall incidence of king crab glochete larvae was 0.69/stomach. Extrapolations from these rates to total numbers of crab consumed for one month in this area were 11,500,000,000 king crab and 4,500,000,000 Tanner crab. Non-crab stomach contents were considerably more diverse among the Alaska Peninsula samples.

ACCESS # : 257, ADF&G

CITATION : Powell G., and G. McCrary. 1982. Is the gold rush over? Alaska Fish Tales & Game Trails, Summer 1982. 17-19 pp.

KEY-WORDS: Red king crab; Commercial fisheries.

SYNOPSIS : The document examines the recent "crash" of the red king crab fishery of the southeastern Bering Sea. In 1980 the commercial harvest was the historic high of 59.1 thousand mt. The 1981 harvest declined to 15.4 thousand mt, and in 1982 the harvest was the historic low of only 1.3 thousand mt. A possible factor in this decline is heavy predation pressure by bottomfish (e.g., Pacific cod, yellowfin sole, Pacific halibut).

ACCESS # : 258, IMS-UAF

CITATION : Thorsteinson, F.V., and L.K. Thorsteinson. 1982. Finfish resources. pp. 111-139 In: M.J. Hammedi (ed.), Proceedings of a synthesis meeting: the St. George Basin environment and possible consequences of planned offshore oil and gas development; Anchorage, Alaska, April 28-30, 1981. NOAA, OMPA, OCSEAP.

KEY-WORDS: Fisheries resources; North Aleutian Shelf; St. George Basin.

SYNOPSIS : Species considered in this document included red king crab, Tanner crab, yellowfin sole, rock sole, flathead sole, Greenland turbot, Pacific halibut, Pacific herring, sablefish, and walleye pollock. These fish, with the possible exceptions of sablefish and turbot, occupy the waters of the North Aleutian Shelf seasonally as adults or during early developmental stages. Because of this, the North Aleutian Shelf fisheries workshop concentrated mainly on salmon of Bristol Bay and the north side of the Alaska Peninsula, and the potential impacts of OCS development on these stocks.

ACCESS # : 259, IMS-UAF

CITATION : VTN Oregon. 1983c. Cruise Report: Cruise MF 83-5 (RP-MF-83B, Leg 11), 9-23 September 1983, OCSEAP Red King Crab Distribution. VTN Oregon, Inc. Wilsonville, OR. 6 pp.

KEY-WORDS: King crab; Distribution; Juveniles; Larvae.

SYNOPSIS : Plankton and epibenthic samples were collected in the North Aleutian Basin to determine the apparent distribution of larvae and early Juvenile red king crabs (Paralithodes camtschatica). Ancillary physical, chemical and biological data for subsequent correlations to the apparent distribution pattern(s) were also gathered.

ACCESS # : 260, IMS-UAF

CITATION : Weber D.D., and T. Miyahara. 1962. Growth of the adult male king crab Paralithodes camtschatica (Tilesius). USF&WS Fish. Bull. 200, 62: 53-75

KEY-WORDS: King crab; Growth.

SYNOPSIS : Estimates of the average growth rates of the eastern Bering Sea male king crab, Paralithodes camtschatica, are presented. Through examining the advancement of modal groups in size-frequency distributions collected in 5 successive years, the growth rate of the smaller adult male crabs is described. For the larger sizes the growth per molt observed in tagged individuals and the proportion of molting crabs observed in each year are combined in a theoretical model which represents the progression of a year class through time. The resulting growth curves calculated from the 1956, 1958, and 1959 data are strikingly similar and show that male crabs 80 mm in carapace length will attain an average length of 168 mm after 8 years of growth. Crabs growing at the rate depicted for 1957 would be 153 mm in length at the end of an equal period.

ACCESS # : 261, ADF&G

CITATION : Barton, L.H., and D.L.Steinhoff. 1980. Assessment of spawning herring (Clupea harengus pallasii) stocks at selected coastal areas in the eastern Bering Sea. Alaska Department of Fish and Game Informational Leaflet No. 187. 60 pp.

KEY-WORDS: Stock assessment; Herring; Spawning.

SYNOPSIS : A 2-year study of Pacific herring, Clupea harengus pallasii, was conducted by the Alaska Department of Fish and Game along the eastern Bering Sea coast from Bristol Bay to Bering Strait to assess biomass and distribution of spawning populations as well as to collect other biological baseline data. Aerial surveys were used as the primary tool for gathering information on timing, distribution, and abundance, while ground crews deployed to selected areas along the coast obtained data on age, sex, size, and maturity composition using variable mesh gill nets to sample within major spawning areas. Major herring spawning concentrations occurred in the Togiak District of Bristol Bay, Security Cove, Goodnews Bay, Nelson Island, and Cape Romanzof in the Yukon-Kuskokwim area, and at Kikitarik and Cape Denbigh in Norton Sound. Herring are known to spawn in the Shishmaref and Kotzebue areas, but occurrence of spawning and assessment of spawning biomass have not been documented north of Bering Strait.

ACCESS # : 262, ARL

CITATION : Fisher, R.B. 1980. The joint venture for Yellowfin Sole, Bering Sea, Summer 1980; A case study in fishery development. Sponsored by The Alaska Fisheries Development Foundation and North Pacific Fishery Management Council. 89 pp.

KEY-WORDS: Yellowfin sole; Fishery development; Joint venture.

SYNOPSIS : Marine Resources Company inc. of Seattle, Washington conducted a Joint venture fishery involving three USSR processing ships and five small to medium-sized American trawlers in the southeastern Bering Sea in the summer of 1980 (June 3 to September 18, 1980). The five American catcher boats caught 8,638 mt of food-grade yellowfin sole (Limanda aspera), 1,142 mt of Pacific cod (Gadus macrocephalus), and 3,118 mt of fishmeal-grade product for a grand total of 13,177 mt, valued at approximately \$1,588,000 (ex-vessel value) during this period. The catches were immediately transferred via detachable cod ends to three Soviet processing ships for processing and freezing. The yellowfin sole (and smaller amounts of rock sole, Alaska plaice and lemon sole) were four to a carton. The Pacific cod was headed and gutted and frozen in similar blocks. Small fish, damaged fish, cod offal, and "trash" species were processed into meal. The product was transported to the USSR and then marketed in the USSR and Africa. The subsequent sale of the product resulted in "export dollars" coming home to the United States. The fishery was an economic success for the participating American trawlers, Soviet processing ships, and Marine Resources Co. inc. The fishery was the first commercial penetration by American vessels in the Bering Sea yellowfin sole fishery, a species previously exploited only by foreign nations. Careful and detailed planning for the fishery began in October of 1978. It is felt that the planning and execution of this fishery may serve as a case study in groundfish development in Alaskan waters.

ACCESS # : 263, ADF&G

CITATION : Fried, S., and J. Skrade. 1982. Bering herring: it's more than just bait. Alaska Fish Tails and Game Trails, Summer 1982, 10-11 & 16 pp.

KEY-WORDS: Herring; Commercial fisheries; Kelp.

SYNOPSIS : This document assesses the recent "sacroe" and "roe-on-kelp" herring fishery in the eastern Bering Sea.

ACCESS # : 264, U. Minnesota, Minn, MN

CITATION : Garshelis, D.L. 1983. Ecology of sea otters in Prince William Sound. PH.D. Dissertation, University of Minnesota, Minneapolis, MN. 321 pp.

KEY-WORDS: Sea otter; Copulation dynamics; Trophic interactions; Marine mammals.

SYNOPSIS : This document examines five aspects of the sea otter ecology in Prince William Sound: 1) social organization; 2) foraging strategies and prey consumption in areas with differing food resources; 3) activity; 4) movements with implications for management; and 5) examination of a sea otter-shellfishery conflict.

ACCESS # : 265, NMFS

CITATION : Hughes, S.E., R.W. Nelson, and R. Nelson. 1977. Initial assessments of the distribution, abundance, and quality of subtidal clams in the S.E. Bering Sea. NOAA/NMFS, NWAFC, Seattle, WA. 43 pp. + Appendix.

KEY-WORDS: Bivalves; Distribution; Abundance; Resource assessment.

SYNOPSIS : Results of the phase I survey indicated low clam abundance in the offshore southeastern Bering Sea *survey* area where survey depths were primarily 20-30 fms, while the possible surf clam resource detected along the Alaska Peninsula was at depths of 10-20 fms. The more detailed phase II survey of the Peninsula area indicated the surf clam resource to occur over a 1,600 square mile area, primarily at depths of 13-18 fms,

ACCESS # : 266, ADF&G

CITATION : McBride, D., and C. Whitmore. 1981. Age composition of Pacific herring, *Clupea harengus pallasii* (Valenciennes) in the Togiak District of Bristol Bay during the 1979 and 1980 spawning seasons. ADF&G Informational Leaflet No. 191, 27 pp.

KEY-WORDS: Age composition; Herring; Spawning; Fisheries.

SYNOPSIS : Age composition of Pacific herring (*Clupea harengus pallasii*) in the Togiak District of Bristol Bay was examined for the 1979 and 1980 spawning seasons. Samples from both the commercial harvest and catches obtained by test fishing with variable mesh gillnets were examined for both years. This study reports on an analysis of: (1) age composition of the commercial harvests during 1979 and 1980, and (2) age composition estimates of the total spawning migrations calculated from commercial purse seine and test fishing data. Herring samples from the commercial catch were collected to determine difference in age composition by gear, area, and time periods. Temporal differences in age composition were apparent between weekly time periods during 1979 as the proportion of younger fish in the commercial harvest steadily increased during the later portion of the fishery. The 1973 and 1974 year classes represented approximately 80% of the total commercial harvest during both 1979 and 1980. Test fish samples for all areas within weekly time periods were combined as a result of the lack of variation in the commercial harvest estimates. Due to consistent differences in age composition and gonad conditions samples collected from the Nushagak Peninsula area were not included with the rest of the test fishing samples. It was concluded that these data supported the hypothesis that the majority of herring in the Nushagak Peninsula area were spent fish that were exiting the inshore spawning areas. Temporal differences in age composition were apparent in test fishing catches during both 1979 and 1980.

ACCESS #: 267, RAS-UAF

CITATION : Gill, R.E., Jr., M.R. Petersen, and P.L.D. Jorgensen. 1981. Birds of the northcentral Alaska Peninsula, 1976-1980. *Arctic* 34: 286-306.

KEY-WORDS: Seabirds; Waterfowl; Shorebirds; Habitat; Distribution; Food habits; Port Moller.

SYNOPSIS : Year-round observations on 125 species of birds at Port Moller, Herendeen Bay, and Nelson Lagoon are presented. Breeding, migration, and roosting habits are discussed for 104 species. Twenty species of marine birds visit the area as non-breeders. Glaucous-winged gull colonies of the vicinity are some of the largest in the state. Seventeen species of waterfowl visit the area as non-breeders, another 16 as known or probable breeders. The lagoon complex is especially important as migration and wintering habitat for 7 species of waterfowl. Eighteen species of shorebirds visit the area as non-breeders, another 9 as known or probable breeders. The lagoon complex is an important migration habitat for at least 6 species of shorebirds. Information on food habits of major species is presented.

ACCESS #: 268, ADF&G

CITATION : Krogman, B.D., H.W. Braham, R.N. Sonntag, and R.G. Punsly. 1979. Early spring distribution, density, and abundance of the Pacific walrus (*Odobenus rosmarus*) in 1976. Unpublished Final, Subcontract R 7120804, RU 14. 47 pp. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Walrus; Distribution; Marine mammals; Sea ice.

SYNOPSIS : This report summarizes results of a cooperative aerial survey (NMFS, ADF&G, USSR) flown over the ice-covered portion of the Bering Sea from March to June, 1976. Walrus concentrations were noted west of St. Lawrence Island and at the ice edge in Bristol Bay.

ACCESS # : 269, ADF&G

CITATION : Burns, J.J.. 1967. The Pacific Bearded Seal. ADF&G, Juneau. 66 pp.

KEY-WORDS: Bearded Seal; Marine mammals; Distribution; Trophic dynamics; Feeding habits.

SYNOPSIS : This report presents information on bearded seal distribution and feeding habits. Bearded seals are described as benthic predators on a wide variety of benthic infauna, epifauna, and fish.

ACCESS # : 270, ADF&G

CITATION : Popov, L.A.. 1976. Status of main ice forms of seals inhabiting waters of the USSR and adjacent to the country's marine areas. Report to FAO Advisory Comm. Mar. Resource Res., ACMRR/MM/SC/51. 17 pp.

KEY-WORDS: Ringed seals; Bearded seals; Larga seals; Ribbon seals; Distribution; Reproduction; Feeding; Mortality; Marine mammals; Sea ice.

SYNOPSIS : A summary of information of distributions, migration, reproduction, feeding, mortality, exploitation, and trophic interactions of ice-inhabiting seals of the Bering Sea and Sea of Okhotsk.

ACCESS # : 271, RAS-UAF

CITATION : Kenyon, K.W.. 1969. The sea otter in the eastern Pacific Ocean. USF&WS. North America Fauna Number 68. 352 pp.

KEY-WORDS: Sea otter; Marine mammals; Population ecology; Trophic dynamics; Feeding behavior.

SYNOPSIS : A major and comprehensive study of seactters, with descriptions of food requirements and feeding habits, population distribution and habitat requirements systematic, general biology and behavior, and reproduction.

ACCESS # : 272, IMS-UAF

CITATION : Fay, F.H., H.M. Feder, and S.W. Stoker. 1977. An estimation of the impact of the Pacific walrus population on its food resources in the Bering Sea. Final Rep. to the Marine Mammal Commission. Contracts MM4AC-006 and MM5AC-024. 38 pp. US MarineMammal Commission, Washington, D.C.

KEY-WORDS: Walrus; Feeding; Trophic dynamics; Predation; Marine mammals.

SYNOPSIS : This paper compares benthic standing stocks as assessed by grab stations over the eastern Bering and Chukchi Seas with walrus predation as evidenced from stomach samples collected in the northern Bering Sea in spring. An estimated 11,000,000 tons of benthos are consumed annually by the walrus population of the Bering-Chukchi shelf, which probably about equals or exceeds the annual net productivity of preferred prey species.

ACCESS #: 273, IMS-UAF

CITATION : Fay, F.H., and S.W. Stoker. 1982. Analysis of reproductive organs and stomach contents from walruses taken in the Alaskan Native harvest, Spring 1980. USF&WS Final rep. 14-16-0007-81-5216. Ammended, 86 p p.

KEY-WORDS: Walrus; Trophic dynamics; Feeding habits; Food Requirements; Reproduction; Marine mammals.

SYNOPSIS : This report discusses the results of analyses of reproductive tracts and stomachs taken by native hunters during the spring of 1980. Results indicate that reproductive success has declined in recent years, perhaps as a result of increasing predation pressure on food resources of the region.

ACCESS # : 274, IMS-UAF

CITATION : Fay, F.H. and S.W. Stoker. 1982. Reproductive success and feeding habits of walruses taken in the 1982 spring harvest, with comparisons from previous years. Contract Rep. to the Eskimo Walrus Commission. Kawerak, inc. P.O. Box 948, Nome, AK. 91 pp.

KEY-WORDS: Walrus; Trophic dynamics; Feeding habits; Reproduction; Marine mamma is.

SYNOPSIS : This report discusses the results of reproductive tracts and stomachs of walrus taken by native hunters during the spring of 1982. Results indicate declining reproductive success, perhaps due to a depleted food supply.

ACCESS # : 275, RAS-UAF

CITATION : Outram, D.N. 1958. The magnitude of herring spawn losses due to bird predation on the west coast of Vancouver Island. Progr. Reports of the Pacific Coast Stations of the Fish. Res. Board of Can. 111: 9-13.

KEY-WORDS: Seabirds; Gulls; Trophic dynamics; Waterfowl; Herring.

SYNOPSIS : Preliminary work indicated that gulls and ducks were responsible for 50% of total herring egg loss. Study indicated that the decrease in egg numbers attributed to bird predation ranged 30-55% and averaged 39% overall. Most loss was in the first 3 days, when birds congregated to feed on both spawning fish and eggs. Later-spawned eggs had better survival. Most predation was by Glaucous-winged and Herring gulls, especially the former species. Glaucous-winged Gulls averaged 13,800 eggs/stomach.

ACCESS # : 276, RAS-UAF

CITATION : Busdosh, M. and R.M. Atlas. 1977. Toxicity of oil slicks to Arctic amphipods. Arctic 30(1): 85-92.

KEY-WORDS: Amphipods; Mortality; Oil spill; invertebrates.

SYNOPSIS : A study was conducted to measure the toxicity of oil spills to Arctic amphipods. Exposure to oil resulted in death, especially if animals physically entered the slicks. Arctic diesel was more toxic than Prudhoe crude oil. Toxicity of Prudhoe crude oil was associated with the paraffinic and aromatic components. Exposure to the tarry asphaltic fraction of crude oil did not result in amphipod mortality.

ACCESS # : 277, ADF&G

CITATION : Kenyon, K.W. 1972. Aerial surveys of marine mammals In the Bering Sea, 6-16 April, 1972. Unpublished Report, Bureau of Sport Fishery and Wildlife, USF&WS, Seattle, 79 pp.

KEY-WORDS: Marine Mammals; Walrus; Distribution.

SYNOPSIS : This report presents the results of an aerial survey conducted over the Bering Sea. For walrus, the main population concentrations were found west of St. Lawrence Island and in central Bristol Bay.

ACCESS # : 278, RAS-UAF

CITATION : Harrison, C.S. 1979. The association of marine birds and feeding gray whales. Condor 81: 93-95.

KEY-WORDS: Seabirds; Marine mammals; Trophic dynamics; Ecology; Behavior.

SYNOPSIS : Author presents information on marine birds feeding in mud patches kicked up by feeding gray whales in inner-shelf areas of the upper Bering and southern Chukchi seas. Thirteen species were recorded in association with gray whales, and the associations occurred 69% of the time. Glaucous Gulls were the most common, with the other species being recorded much less commonly. The author suggests that gray whales provide an important supplemental source of food to several seabird species in the area.

ACCESS # : 279, ARL

CITATION : Ohlendorf, H.M., J.C. Bartonek, G.J. Divoky, E.E. Klass, and A.J. Koynitsky. 1982. Organochlorine residues in eggs of Alaskan seabirds. U.S. Fish & Wildl. Serv, Spec. Sci. Rept. - Wildl. No. 245: 1-41.

KEY-WORDS: Seabirds; Organochlorine contamination; Aleutian Islands; Pribilof Islands; Seward Peninsula.

SYNOPSIS : Information on 13 organochlorine residues in seabird eggs collected at 18 sites in Alaska from 1973 to 1976 is presented. Data include samples from eggs collected at Cape Peirce and Round Island. The mean frequencies of occurrence were the lowest in Bristol Bay of five geographic areas for DDD, DDT, and Toxaphene and were the highest for mirex and Cis-nonachlor; intermediate values were recorded for the other eight compounds. Eggs from Bristol Bay had the lowest overall mean frequency of occurrence of all five geographic areas for all 13 compounds. A discussion of the role of foods, migration, and wintering distribution in introducing these contaminants to the species examined, follows.

ACCESS # : 280, RAS-UAF

CITATION : Ogi, H., T Kubodera, and K. Nakamura. 1980, The pelagic feeding ecology of the Short-tailed Shearwater *Puffinus tenuirostris* in the Subarctic Pacific region. J. Yamashina inst. Ornithol. 12: 157-182

KEY-WORDS: Seabirds; Trophic dynamics; Trophic interactions; Ecology.

SYNOPSIS : information on the food habits of 439 Short-tailed Shearwaters collected in the Sea of Okhotsk, North Pacific, and Bering Sea between 1970 and 1978 is presented. Birds from Bristol Bay had the highest mean amount of food per bird of all sampling areas. Birds there contained large quantities of euphausiids (*T. raschii*) and trace amounts of juvenile fishes (Ammodytes). in the Bering Sea overall, prey items were ranked: euphausiids, squid, amphipods, and fishes (in decreasing order of importance). They conclude that consumption of euphausiids in Bristol Bay (based on a population estimate of 5-7 million birds) would be over 30,000 mt during a 2-month period, or equal to the consumption of euphausiids in the same area by sockeye salmon on their way to spawn.

ACCESS # : 281, RAS-UAF

CITATION : Threlfall, W., E. Eveleigh, and J.E. Maunder. 1974. Seabird mortality in a storm. Auk 91: 846-849.

KEY-WORDS: Seabirds; Gulls; Mortality; Storm effects.

SYNOPSIS : A severe storm hitting a seabird colony at Gull Island, Newfoundland, on 16-18 June 1973 caused severe damage to seabird reproduction there. Mortality was estimated at 90-91% of the Herring Gull reproductive effort for that year. The storm also caused massive reproductive failures in Herring Gulls and Ring-billed Gulls elsewhere in Newfoundland. Examples of the effects of storms on reproduction in other species are also given.

ACCESS # : 282, ARL "

CITATION : Schneider, D., and G.L. Hunt. 1982. Carbon flux to seabirds in waters with different mixing regimes in the southeastern Bering Sea. Mar. Biol. 67: 337-344.

KEY-WORDS: Seabirds; Distribution; Trophic dynamics; Biomass.

SYNOPSIS : This paper presents information on food requirements and energy flux to seabirds in the middle and outer shelf domains and the continental slope waters of the extreme southeastern Bering Sea. Biomasses of surface feeders were greatest over slope waters; of diving feeders, over outer-shelf waters. Consumption of juvenile pollock for the area was estimated at 150,000 metric tons/year. Energy flow to surface feeders was 3 times higher in outer-shelf and slope waters than in middle-shelf waters. Energy flow to diving feeders was relatively uniform across all water masses.

ACCESS # : 283, RAS-UAF

CITATION : Kessel, B., and D.D. Gibson. 1978. Status and distribution of Alaska birds. Stud. Avian Biol. 1: 1-100.

KEY-WORDS: Seabirds; Alaska; Bristol Bay; Distributions; Waterfowl; Shorebirds.

SYNOPSIS ": Besides publishing updated distributional information on 202 species of birds from Alaska, good information on nesting colonies of Aleutian Terns in the area of concern is presented.

ACCESS # : 284, ARL

CITATION : Sanger, G. A. 1983. Diets and food web relationships of seabirds in the Gulf of Alaska and adjacent marine regions. Final report to OCSEAP, U.S. Fish & Wildlife Service, Anchorage, Ak. 130 pp.

KEY-WORDS: Seabirds; Sea ducks; Waterfowl; Trophic dynamics; Trophic Interactions; Ecology.

SYNOPSIS : Information on the food habits of 42 species of seabirds and six species of sea ducks in the Gulf of Alaska and southeastern Bering Sea is presented. Two of the sampling areas (Cape Peirce and Nelson Lagoon) are in the area of concern. In Bristol Bay, euphausiids and hyperiid amphipods are the most important foods of Short-tailed Shearwaters; squid are also fairly important. Fish, especially pollock, were the most important foods of Black-legged Kittiwakes in Bristol Bay. Fishes (especially capelin and gadids) and euphausiids were the most important foods of Common Murres in Bristol Bay. Food webs, competition, and ingestion of commercially valuable species are discussed. This is an extensive summary of food habits.

ACCESS #: 285, RAS-UAF

CITATION : Bradstreet, M.S.W. 1982. Occurrence, habitat use, and behavior of seabirds, marine mammals, and arctic cod at the Pond Inlet ice edge. Arctic 35: 28-40.

KEY-WORDS: Seabirds; Marine mammals; Sea ice; Trophic interactions; Habitat ecology; Fishes.

SYNOPSIS : Results of surveys at Pond Inlet ice edge, in Canadian high arctic, to determine occurrence, distribution, and habitat use of birds, mammals, and fish. A total of twelve species of seabirds, four of waterfowl, and two other species of birds were seen using the ice edge. Murres, Northern Fulmars, and Black-legged Kittiwakes were the most abundant species. Birds were most common when there was <50% ice cover; overall densities ranged 38-46 birds/km of ice edge. Seven species of marine mammals occurred at the ice edge; the most common species were narwhals and white whales. Densities ranged between 0.5-1.5 marine mammals/km of ice edge. Arctic cod tended to congregate in crevices under the ice edge. The importance of the ice edge for feeding, reproduction, and open-water for breathing, are discussed. Primary foods of the birds and mammals were arctic cod and hyperiid amphipods.

ACCESS #: 286, RAS-UAF

CITATION : Hurley, J.B. 1931. Birds observed in the Bristol Bay region, Alaska (Part 11). Murrelet 12: 34-42.

KEY-WORDS: Seabirds; Gulls; Distribution.

SYNOPSIS : Mew Gulls were the most abundant gull in Bristol Bay. Bonaparte's Gulls were fairly common and nested in scattered spruce trees. Sabine's Gulls were found to nest this far south, an extension of the nesting range from the Kuskokwim River delta. Arctic Terns occurred in low numbers throughout the bay. Author claimed that there was a bounty on this species, for it eats many salmon fry. (See response by Flock, 1932, Murrelet 13: 26).

ACCESS #: 287, RAS-UAF

CITATION : Ryder, R.A. 1957. Avian - pinniped feeding associations. Condor 59: 68-69.

KEY-WORDS: Seabirds; Pinnipeds; Petrels; Gulls; Phalaropes; Terns; Trophic Interactions; Marine mammals.

SYNOPSIS : Several seabird - pinniped associations are discussed from icebreaker work in the North Pacific and Arctic Oceans. Ivory and Glaucous gulls feed on walrus feces; Red Phalaropes feed in water in the midst of swimming walruses. Black-legged Kittiwakes and Glaucous and Ivory gulls feed on ringed seal remains. Northern Fulmars, Sabine's Gulls, Arctic Terns, Red Phalaropes, and Herring Gulls feed near feeding ringed seals, taking food scraps left over. Pomarine and Parasitic Jaegers work nearby, stealing food from these other species. Short-tailed Shearwaters feed on food scraps left by feeding Steller sea lions, with up to 30 birds around each sea lion. Fork-tailed Storm-Petrels and Northern Fulmars feed around foraging northern fur seals. The birds gain food and the pinnipeds may at times locate food through looking for feeding frenzies of birds.

ACCESS # : 288, RAS-UAF

CITATION : Mossman, A.S. 1958. Selective predation of Glaucous-winged Gulls upon adult red salmon. Ecology 39: 482-486. "

KEY-WORDS: Gulls; Salmon; Seabirds; Trophic interactions.

SYNOPSIS : Study was done at Wood River Lakes system of Bristol Bay. A total of 81 salmon was killed over a few-day period in late July. 65 of these were females, indicating that the gulls actively selected for females. Of 15 salmon killed by gulls on a nearby creek, 12 were females, again indicating selective predation on female salmon. The gulls also open the abdominal cavity of female salmon much more frequently, and eat the viscera and (especially) the eggs. The gulls apparently use the sexual dimorphism characters of the salmon to selectively take females.

ACCESS # : 289, RAS-UAF

CITATION : Osgood, W.H. 1904. A biological reconnaissance of the base of the Alaska Peninsula. N. Am. Fauna 24: 1-86.

KEY-WORDS: Marine mammals; Seabirds; Shorebirds; Waterfowl; Distribution.

SYNOPSIS : This report summarizes data gathered in 1902 in the Alaska Peninsula area, and on a canoe i-rip from Nushagak to Cold Bay. An annotated species list for all birds and mammals in the area is presented, and vegetation, climate, topography, and ecology of the area are discussed.

ACCESS # : 290, WILDL. DEPT. -UAF

CITATION : Bartonek, J.C., and S.G. Scaly. 1979. Distribution and status of marine birds breeding along the coasts of the Chukchi and Bering seas. USF&WS Wildl. Res. Rept. 11: 21-31.

KEY-WORDS: Seabirds; Waterfowl; Distribution.

SYNOPSIS : A summary of seabird colony locations and sizes in the Bering and Chukchi, exclusive of the Aleutian Islands. From preliminary surveys, it appears that nearshore Bristol Bay contains one colony > 1 million birds, three colonies > 100,000 birds, and many smaller colonies. At least 11 species of seabirds nest in nearshore Bristol Bay (NOTE: several other seabird species were not considered in this analysis). Authors recommend more thorough censusing, and initiation of long-term studies.

ACCESS # : 291, USF&WS

CITATION : Trapp, J.L. 1979. Concept plan for the preservation of migratory bird habitat, Part 2: Seabirds. Unpubl. manuscript on file at U.S. Fish & Wildlife Service, Anchorage, Ak. 59 pp.

KEY-WORDS: Seabirds; Aleutian Islands; Management; Distribution.

SYNOPSIS : This manuscript presents a method for objectively ranking the 70 most important seabird colonies in Alaska. Using information on species composition and total colony size from The Catalog of Alaskan Seabird Colonies (Sowls et al., 1978), Trapp arrives at "composite species scores" for each colony. Trapp then ranks these colonies on decreasing order of importance by "composite species score". Of the 70 largest seabird colonies in Alaska, three are found in the Bristol Bay area. The Cape Newenham/Cape Peirce complex is the eleventh most important colony in the state, the Walrus Islands complex is ranked as the fifteenth most important, and Amak Island is the sixtieth most important. Nearby, the Pribilof Islands complex is ranked as the most important seabird colony in Alaska. A discussion of the proposed U.S. Fish and Wildlife Service preservation program follows.

ACCESS # : 292, USF&WS

CITATION : Gould, P.J., D.J. Forsell, and C.J. Lensink. 1982. Pelagic distribution and abundance of seabirds in the Gulf of Alaska and eastern Bering Sea. FWS/OBS - 82/48: 294 pp. USF&WS, Biological Services Program, Anchorage, Ak.

KEY-WORDS: Seabirds; Distribution; Ecology; Aleutian Islands.

SYNOPSIS : An analysis of thousands of pelagic bird transects in the Gulf of Alaska and southeastern Bering Sea is presented. Survey techniques, biases, and accuracies are discussed. Annotated species lists for birds in the Gulf and in the Bering are presented separately. Few transects have been conducted in the nearshore waters of Bristol Bay, although large numbers have been conducted in Bristol Bay as a whole. Greatest overall densities in nearshore Bristol Bay were recorded near Unimak Pass, offshore from Izembek Lagoon and Port Moller, and in upper Bristol Bay from Cape Newenham to the mouth of the Egegik River. Density maps for individual species are presented, by season, as 20' latitude x 30' longitude blocks.

ACCESS # : 293, RAS-UAF

CITATION : Flock, C. 1932. Notes on the Arctic Tern In Bristol Bay region, Alaska. Murrelet 13: 26.

KEY-WORDS: Seabirds; Arctic Tern; Salmon; Gulls; Trophic interactions; Mortality.

SYNOPSIS : No bounty paid on terns in Bristol Bay, but fishermen regularly shot them and destroyed nests. Claims were that they are "extremely destructive" to young salmon. As many as 72 young salmon were found in one bird stomach. The author considered only trout to be worse predators on young salmon. He also states that most terns nest by the thousands near lakes where salmon spawn, and that this is where most young salmon are caught. Unlike gulls (Glaucous-winged Gulls), which can only take young salmon in shallow, quiet water, the terns can catch them in both flowing and quiet waters. This paper is a response to comments in a paper by Hurley (Murrelet 12: 34-42, 1931).

ACCESS # : 294, ARL

CITATION : Gill, R., Jr., C. Handel, and M. Petersen. 1979. Migration of birds in Alaska marine habitats. Annual Reports of Principal Investigators. vol. 5. pp. 245-288. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Seabirds; Waterfowl; Shorebirds; Migration; Distribution.

SYNOPSIS : Summaries are presented for 19 species of seabirds, shorebirds, and waterfowl in Alaska. Large movements of shearwaters 2-5 Km offshore from the Alaska Peninsula occur in May-August; large concentrations are also found in Umiak Pass in spring and fall. Cormorants migrate coastally in nearshore Bristol Bay, with the largest flock seen of about 10,000 pelagics in late April near Hagemester Strait; most or all cormorants leaving the Bering Sea do so through Umiak Pass in September-October. Almost all of the world's Black Brant stage in spring and fall in the shallow lagoons of the Alaska Peninsula. Emperor Geese winter along the lagoons and coast of the Alaska Peninsula and Aleutian Islands. The entire world's population of Steller's Eiders stages in lagoons along the north side of the Alaska Peninsula. Major wintering areas of Common Eiders occur in the southern Bering Sea and Bristol Bay. King Eiders congregate to winter in the lagoons of the Alaska Peninsula and eastern Aleutians. Three species of scoters stage in waters off the Alaska Peninsula. many shorebirds breeding in western Alaska migrate across the base of the Alaska Peninsula and upper Bristol Bay. Black-legged Kittiwakes tend to concentrate in late fall in Bristol Bay, and later leave the Bering Sea through Umiak Pass. Murres breeding in the Bering Sea migrate primarily through Umiak Pass. A discussion of migration patterns and data gaps follows.

ACCESS # : 295, IMS-UAF

CITATION : Bartonek, J.C., R. Elsner, and F.H. Fay. 1974. Mammals and birds, p. 23-28. IN: PROBES: A prospectus on Processes and Resources of the Bering Sea Shelf, Inst. Mar. Sci., University of Alaska, Fairbanks.

KEY-WORDS: Seabirds; Waterfowl; Shorebirds; Marine mammals; Oceanography.

SYNOPSIS : This report is one section generated at an NSF sponsored workshop for generating a national/international study of the oceanography of the Bering Sea. The Bering Sea has the greatest diversity of pagophilic marine mammals in the world, and one of the largest concentrations of seabirds in the Western Hemisphere. Most activity is concentrated over the shelf. The 25 species of marine mammals consume an estimated 9-10 million mt of food annually. The 40 species of seabirds consume at least 1 million mt of food annually. The Bering Sea contains many endemic species of marine mammals, seabirds, shorebirds and waterfowl. international implications, potential conflicts, and research opportunities are discussed, and recommended research goals are presented.

ACCESS # : 296, RAS-UAF

CITATION : Gill, R.E., and G.A. Sanger. 1979. Tufted Puffins nesting in estuarine habitat. Auk 96:792-794.

KEY-WORDS: Seabirds; Tufted Puffin; Nelson Lagoon; Distribution.

SYNOPSIS : Most Tufted Puffins nest on high rocky islands and cliffs. This paper reports on a small nesting colony at Nelson Lagoon, Alaska Peninsula, where the birds nested in burrows among vegetation on 1-2 meter high islands. Storm tides flooded burrows and killed some chicks. Adults walked to the beach and took flight. Authors speculate that presence of relatively little seabird breeding habitat in Bristol Bay leads to intense inter and intraspecific competition for nest sites, leading to colonization of abnormal habitat.

ACCESS # : 297, RAS-UAF

CITATION : **Murie, O.J.**, 1959. Fauna of the **Aleutian Islands** and Alaska Peninsula. North American Fauna. No. **61**: 1-364.

KEY-WORDS: Seabirds; Waterfowl; Shorebirds; Marine mammals; Alaska Peninsula; Aleutian Islands; **Biology**; Distribution; Migration; **Trophic** dynamics.

SYNOPSIS : This monograph summarizes all information on the birds and mammals of this area up to early to mid 1950's, including Murie's extensive field work in the area of the 1920's and 1930's. Climate, vegetation, environment, and zoogeographic aspects of the area are discussed. An annotated bibliography of distribution and abundance, habitat use, and seabird and pinniped breeding colonies is presented. There is an extensive discussion of food habits and feeding ecology of several species. This is the authoritative work on this area.

ACCESS #: 298, USF&WS

CITATION : **Kenyon, K.W.**, and **J.G. King, Jr.**. 1965. Aerial survey of sea otters and other marine mammals, Alaska Peninsula and Aleutian Islands, 19 April to 9 May 1965, and bird observations, Aleutian Islands survey, April-May 1965. Unpublished Manuscript on file at USF&WS, Anchorage, Alaska. 61 pp.

KEY-WORDS: Marine mammals; Distribution; Waterfowl; Aleutian Islands.

SYNOPSIS : This report summarizes results of aerial surveys flown for marine mammals and birds between Anchorage and the western Aleutian Islands in spring 1965. Approximately 17,000 adult and large juvenile otters were estimated in the area; approximately 4,000 were estimated between Unimak Pass and Port Moller. The greatest concentration of otters in the area of concern was seen from Bechevin Bay to east of Izembek lagoon. Counts of Steller sea lions and harbor seals are also presented. Information on waterfowl indicated 33,000 Emperor Geese in lagoons on the north side of the Alaska Peninsula, and "huge flocks" of Common Eiders were noted off the Alaska Peninsula at this time.

ACCESS # : 299, RAS-UAF

CITATION : Wahl, T.R., 1978. Seabirds in the northwestern Pacific Ocean and south central Bering Sea in June 1975. *Western Birds*. 9: 45-66.

KEY-WORDS: Seabirds; Distribution; Behavior.

SYNOPSIS : This paper summarizes information on the distribution of seabirds on an oceanographic cruise from Japan to the Bering Sea. Birds were observed in the southeastern Bering Sea/outer Bristol Bay area over a period of 5 days. Greatest densities were seen in the Unimak Pass area, consisting primarily of Northern **Fulmars**, Short-tailed Shearwaters, Fork-tailed Storm Petrels, Black-legged **Kittiwakes**, Thick-billed **Murres**, and Tufted Puffins. An annotated list discusses the distribution and behavior of all species seen, and bird densities in various water masses are discussed.

ACCESS # : 300, ARL

CITATION : Royer, T.C. 1979. On the effect of precipitation and runoff on coastal circulation in the Gulf of Alaska. *J. of Phys. Oceanogr.* 9: 555-563.

KEY-WORDS: Gulf of Alaska; Coastal circulation; Freshwater runoff; Oceanography.

SYNOPSIS : Surface waters in the Gulf of Alaska undergo a net dilution throughout most of the year since the regional precipitation exceeds evaporation. Recent hydrographic data give evidence that seasonal dynamic height fluctuations in the upper layers (<100 m) are well-correlated with the seasonal changes in precipitation and runoff. The precipitation effect is magnified by coastal mountain ranges which enhance the rainfall at or near the coast, contributing fresh water at the coast through runoff. Previous estimates of the offshore precipitation gradient appear to be smaller than those measured recently. Precipitation and runoff alter the dynamic height through salinity changes. This dependence of dynamic height on salinity is possible here because of the high precipitation (>130 cm year⁻¹), runoff, longshore accumulation of fresh water around the gyre, and the low water temperatures. The coastal sea level is in phase and has nearly the same amplitude as the local dynamic height, though not in phase with heating and cooling.

ACCESS # : 301, IMS-UAF

CITATION : Kelley, J.J., and D.W. Hood. 1974. Upwelling in the Bering Sea near the Aleutian Islands. *Tethys* 6 (1-2): 149-156.

KEY-WORDS: Upwelling; Aleutian Islands; Carbon dioxide; Nutrients; Oceanography.

SYNOPSIS : Continuous measurement of equilibrium partial pressures of carbon dioxide on the surface seawater was used to delineate the spatial extent of upwelling near the eastern Aleutian Islands. Near-surface water in the vicinity of Amukta and Samalga Passes had carbon dioxide partial pressures of 500 ppm, nutrient concentrations of over 15 ug-atoms $\text{NO}_3\text{-N/liter}$, 2.5 ug-atoms $\text{PO}_4\text{-P/liter}$ and 70 ug-atoms $\text{SiO}_2\text{-S/liter}$. Associated with the upwelled areas were low surface-water Temperature, low oxygen concentration and high salinity anomalies. Subsurface sampling revealed a complicated distribution of chemical parameters suggestive of turbulence and mixing effects. These anomalies were most intense in the vicinity of subsurface valleys and ridges.

ACCESS # : 302, RAS-UAF

CITATION : Swift, J.H., and K. Aagaard. 1976, Upwelling near Samalga Pass. *Limnol. Oceanog.* 21(3): 399-408.

KEY-WORDS: Upwelling; Aleutian Islands; Samalga Pass; Oceanography.

SYNOPSIS : Recent summer hydrographic data from the vicinity of Samalga Pass in the eastern Aleutians show upwelling of relatively saline water, poor in oxygen and rich in nutrients. A steady state oxygen model in which the photosynthetic production of oxygen in the euphotic zone is balanced by an upwelling of low-oxygen water yields an upper bound on the vertical velocity of 7,000 cm/s. Examination of various possible driving mechanisms for the upwelling, including winds and entrainments suggests that the upwelling is driven by subsurface convergence.

ACCESS # : 303, ARL

CITATION : Coachman, L.K., and J.J. Walsh. 1981. A diffusion model of cross-shelf exchange of nutrients in the southeastern Bering Sea. Deep Sea Res. 28A(5): 819-846.

KEY-WORDS: Models; Nutrient cycling; Transport; Cross-shelf; Primary production Oceanography.

SYNOPSIS : A diffusion model has been used to estimate the spring cross-shelf flux of nitrate and its rate of biological uptake in the southeastern Bering Sea during 1976 to 1979. Vertical fine structure of temperature and salinity and a cross-shelf salt balance were used to estimate eddy coefficients in the diffusive fluxes of nitrate. A combination of the computed physical resupply of nitrate and its observed local time rate of change was then used to predict the rate of nitrate utilization by phytoplankton. Agreement of this model with independent N estimates of formation of phytoplankton particulate nitrogen allowed further analysis of the possible fate of the spring bloom in the outer shelf of the Bering Sea. A comparison of the utilization of spring phytoplankton production is made at the same isobath and similar latitude of the Bering and North seas.

ACCESS # : 304, ARL

CITATION : Schumacher, J.D., T.H. Kinder, D.J. Pashinski, and R.L. Charnel]. 1979. A structural front over the continental shelf of the eastern Bering Sea. J. Phys. Oceanogr. 9: 79-87.

KEY-WORDS: Oceanography; Temperature; Salinity; Structural front.

SYNOPSIS : Conductivity and temperature versus depth (CTD) and expendable bathythermograph (XBT) data taken during the ice-free seasons of 1975-77 define a structural front paralleling the 50 m isobath. This front forms a narrow transition separating a well-mixed coastal domain from a two-layered central shelf domain. In early spring, prior to frontogenesis, we believe that temperature and salinity are continuous across the 50 m isobath. Thus, the front does not result from the confluence of water masses; rather the front permits the evolution of different water masses following frontogenesis. The changing balance between buoyant energy input and tidal stirring determines the frontal location and the frontal width correlates with bottom slope. The front is similar to those reported around the British Isles, but we find that in the Bering Sea the salinity distribution is important, that the ice cover influences the seasonal evolution of the hydrographic structure, and that the geostrophic (baroclinic) speed differences across the front are small (< 2 cm/s). We hypothesize that frontogenesis depends critically on positive feedback between stratification and mixing.

ACCESS # : 305, RAS-UAF

CITATION : Schumacher, J.D., C.A. Pearson, and J.E. Overland. 1982. On exchange of water between the Gulf of Alaska and the Bering Sea through Unimak Pass. J. of Geophys. Res. 87(C8): 2785-5795.

KEY-WORDS: Water exchange; Unimak Pass; Currents; Pressure (bottom) measurements; Oceanography.

SYNOPSIS : We present the first long-term current and bottom pressure observations from Unimak Pass, Alaska, and adjacent locations on the Gulf of Alaska and Bering Sea shelves. Vector mean current recorded between March and August 1980 was 12 cm/s toward 284 degrees T or onto the Bering Sea shelf, however, magnitude decreased from 20 cm/s to 6 cm/s between the first and second halves of the record. At shorter periods (3-10 days), current fluctuations in the pass were strongly coherent (K^2 was greater than or equal to 0.7) with the pressure difference measured along the axis of the pass, and this was coherent with geostrophic wind estimates. The results indicated that wind-induced sea level perturbation was the dominant forcing mechanism for fluctuations. Relations among current, bottom pressure, pressure difference, and geostrophic wind time series also showed that dynamic variation on the Gulf of Alaska shelf was primarily responsible for current fluctuations in the pass. Hydrographic data indicated that a baroclinic current existed along the Gulf of Alaska coast, and this flow became the long-term flow through the pass. We suggest that this feature was the extension of the Kena! Current. The historic supposition that water is transported from the Gulf of Alaska into the Bering Sea was verified; however, the waters are of coastal origin rather than from the Alaskan Stream.

ACCESS # : 306, RAS-UAF

CITATION : Kinder, T.H., and L.K. Coachman. 1978. The front overlaying the continental slope in the eastern Bering Sea. J. Geophys. Res. 83(C9):4551-4559.

KEY-WORDS: Mixing; Continental slope; Structural front; Oceanography.

SYNOPSIS : We use hydrographic data to delineate a diffuse, large (nearly 1000 km long), and persistent (years) haline front which overlies the continental slope in the eastern Bering Sea. The front marks a transition between the waters above the deep basin, where the horizontal salinity gradient is almost zero and the flow is geostrophic, and the waters above the broad shelf, where salinity gradients are large and flow is tidally dominated. We suggest that the change in mixing from the oceanic regime above the deep basin to the tidal regime over the shelf is responsible for the front. Because our arguments do not depend upon features unique to the Bering Sea slope, similar fronts should be found where freshwater runoff can dominate the density gradient and where strong boundary currents are absent.

ACCESS # : 307, ARL

CITATION : Muench, R.D. 1976. A note on eastern Bering Sea shelf hydrographic structure; August, 1974. Deep Sea Res. 23: 245-247.

KEY-WORDS: Oceanography; Hydrographic structure; Baroclinic transport; Currents.

SYNOPSIS : Temperature, salinity, and density structures along a north-south transect across the eastern Bering Sea are characterized. Of particular interest is the detection of a subsurface current core along the 50 m isobath in northwestern Bristol Bay. Some possible relationships between this feature and regional dynamics are discussed applying the vorticity conservation theory qualitatively.

ACCESS # : 308, ARL

CITATION : Coachman, L.K., and R.L. Charnell. 1975. On lateral water mass interaction - A case study, Bristol Bay, Alaska. J. Phys. Oceanogr. 9: 278-297.

KEY-WORDS: Water mass; Mixing; Lateral interaction; Continental shelf.

SYNOPSIS : Salinity-temperature-depth data obtained on several spring and summer cruises during 1976 and 1977 from outer Bristol Bay in the southeast Bering Sea indicate the existence of a zone, between two well-defined water masses, where details of the interaction process are observable. This interaction zone is approximately 100-150 km wide and is characterized by a plethora of mid-water-column fine structure, in both temperature and salinity, that exhibit a hierarchy of vertical scale sizes. Vertical mixing energy within the zone appears low, which results in persistence of interleaving signatures induced by horizontal interaction of two adjacent water masses. Such interaction probably occurs between all laterally juxtaposed water masses of nearly the same density; outer Bristol Bay allows enhanced examination of the process because of the broad lateral extent of the transition zone.

ACCESS # : 309, RAS-UAF

CITATION : Allen, J. S., R.C. Beardsley, J.O. Blanton, W.C. Boicourt, B. Butman, L.K. Coachman, A. Huyer, T.H. Kinder, T.C. Royer, J.D. Schumacher, R.L. Smith, W. Sturges, and C.D. Winant. 1983. Physical oceanography of continental shelves. *Rev. Geophys. Space Phys.* 21(5): 1149-1181.

KEY-WORDS: Oceanography; Continental shelf; Hydrographic structure; Currents; Climatology; Ice; Physical/biological interactions.

SYNOPSIS : Review of the physical oceanography of continental shelves, including that of the eastern Bering Sea. Includes information on hydrographic features, currents, climatology, ice, and physical/biological interactions.

ACCESS # : 310, ARL

CITATION : Kinder, T.H., J.D. Schumacher, and D.V. Hansen. 1980. Observation of a baroclinic eddy: An example of mesoscale variability in the Bering Sea. *J. Phys. Oceanogr.* 10: 1228-1245.

KEY-WORDS: Baroclinic transport; Mesoscale variability; Oceanography.

SYNOPSIS : Drift buoys with shallow (17 m) drogues, released during May 1977 and tracked by satellite, delineated an eddy in the southeastern Bering Sea. Located above complex topography having a depth range of 200 to 3000 m., the eddy had a diameter of about 150 km. Mean rotational speeds 50 km from the eddy's center were 20 cm/s, but speeds up to 50 cm/s were measured. A CTD survey during July defined the eddy from 200 to 1500 m depth in temperature and salinity distributions, but no hydrographic evidence for the eddy existed at the surface. Ageostrophic calculation relative to 1500 m agreed qualitatively with drifter data, but was 5 cm/s less than mean drifter speeds. Examination of the T-S correlations showed that water masses at the eddy's core were the same as those at its periphery, in contrast with a cyclonic ring observed nearby in July 1974. The last drifter left the eddy in October, and a second CTD survey in February 1978 showed that the eddy had either dissipated or moved. An earlier STD survey of the region in summer 1971 had shown neither an eddy like that seen in 1977 nor a ring like that seen in 1974.

ACCESS # : 311, RAS-UAF

CITATION : Reed, R.K., and W.P. Elliott. 1979. New precipitation maps for the North Atlantic and North Pacific Oceans, J. Geophys. Oceanogr. 84(C12): 7839-7846.

KEY-WORDS: Precipitation; North Pacific; North Atlantic; Shemya Island; St. Paul Island; Cold Bay; King Salmon.

SYNOPSIS : Oceanic precipitation intensity values derived in a previous study were combined with precipitation frequency data in the recently revised marine climatic atlases to prepare new annual and seasonal precipitation maps for the North Atlantic and North Pacific oceans. The greatest precipitation over both oceans occurs in the eastern and central tropical regions. A distinct minimum is present across both oceans in the subtropical regions, being most marked along the eastern margins. Secondary maxima are present over the northern regions, where considerable snow falls in winter. The principal seasonal changes are an increase in size and northward migration of the subtropical dry zone from winter to summer as well as reduced magnitude and gradients of precipitation to the north in summer. The tropical Pacific shows a remarkably stable distribution during the year, but the zone of maximum rainfall in the tropical Atlantic undergoes considerable variation in location. The new maps show generally less precipitation in extra-tropical regions than earlier ones, although in the tropics they give values between those of the widely varying previous maps.

ACCESS # : 312, ARL

CITATION : Coachman, L.K., and R.L. Charnell. 1977. Fine structure in outer Bristol Bay, Alaska. Deep Sea Res. 24: 869-889.

KEY-WORDS: Oceanography; Fine structure; Salinity-temperature distribution.

SYNOPSIS : A salinity-temperature-depth (STD) cruise in Bristol Bay in the Bering Sea during March, 1976 showed the existence of a subsurface layer with large density inversions. This fine structure layer, which covered a horizontal distance of some 100 km, showed a maximum negative density gradient of $.000055 \text{ kg/m}^4$. Stations showing these inversions were in the zone of interaction between Bering Sea water and the shelf water of Bristol Bay, which had been displaced 100 km south of its usual location by strong northerly winds. The layer persisted for nearly one week. Hypotheses are advanced to account for its formation and persistences.

ACCESS # : 313, RAS-LJAF

CITATION : Roden, G.I. 1967. On river discharge into the northeastern Pacific Ocean and the Bering Sea. J. Geophys. Res. 72(22): 5613-5629.

KEY-WORDS: Oceanography; River discharge.

SYNOPSIS : The information obtained from monthly mean and extreme river discharge records and the joint variation of salinity and river discharge at coastal stations are analyzed. The average annual fresh water discharge into the Pacific between California and the Aleutian Islands amounts to approximately 21,000 m³/sec. The fresh water discharge into the Bering Sea by Alaska and Siberian rivers occurs at an average annual rate of at least 10,000 m³/sec. There have been no significant trends in natural streamflow during the past half century. Prolonged droughts in the Far West, as those between 1928 and 1931, are caused by a persistent cold, dry anticyclone over the plateau states. Extreme flooding, as in 1861-1862 and 1964-1965, is related to strong polar outbreaks and subsequent invasion of warm moist air from the sub-tropical Pacific. The spectra of river discharge show peaks of meteorological origin at annual and semiannual frequencies and suggest nonlinear interaction.

ACCESS # : 314, ARL

CITATION : Royer, T.C. 1981. Baroclinic transport in the Gulf of Alaska. Part II: A fresh water driven coastal current. J. Mar. Res. 39(2): 251-266.

KEY-WORDS: Oceanography; Coastal current; Baroclinic transport; Freshwater.

SYNOPSIS : A coastal geostrophic, baroclinic Jet in the Gulf of Alaska is driven seasonally by fresh water discharge and winds. The narrow current (<20 km) has a mean transport of 240,000 m³/s (relative to 100 db) and velocities in excess of 66 cm/s. The Jet reaches a maximum in autumn, coincident with maximum fresh water discharge along the coast. The wind, whose maximum is in January-February, affects this current to a lesser degree than fresh water. The linear response of the baroclinic transport anomalies to wind and fresh water anomalies is used to support cause and effect relationships. The fresh, coastal current extends from Southeast Alaska into the western Gulf of Alaska and is the consequence of the accumulation of runoff beginning along the British Columbia coast. The Alaska Coastal Current and the Alaska Current are generally distinct from each other for the region sampled, with one notable exception near Kayak Island. The Alaska Coastal Current could be an important source of fresh water for the North Pacific Ocean.

ACCESS # : 315, RAS-UAF

CITATION : Schumacher, J.D., and R.K. Reed. 1980. Coastal flow in the northwest Gulf of Alaska: The Kenai Current. J. Geophys. Res. 85(C11): 6680-6688.

KEY-WORDS: Oceanography; Kenai Current; Coastal flow.

SYNOPSIS : Recent data from the northwest Gulf of Alaska reveal a coastal current which flows westward along the Kenai Peninsula (mainly within 30 km of shore), enters Shelikof Strait, and exits to the southwest of Kodiak Island. This flow, which we call the Kenai Current, has a large seasonal variation in baroclinic transport and maximum surface speed; transport is typically about 300,000 m³/s but exceeds 1,000,000 m³/s in fall, with concurrent speed increases from 15-30 cm/s to over 100 cm/s. The coastal flow is clearly distinct from the offshore Alaskan Stream; its seasonal signal is mainly related to a cross-shelf pressure gradient, which responds to an annual hydrological cycle. Current records from Shelikof Strait substantiate the presence of an annual signal and indicate that wind forcing has maximum effect from December through February, but it does not appear to augment flow at other times.

ACCESS # : 316, ARL

CITATION : Royer, T.C. 1981. Baroclinic transport in the Gulf of Alaska. Part I: Seasonal variations of the Alaska Current. 1981. J. Mar. Res. 32(2): 239-249.

KEY-WORDS: Oceanography; Baroclinic transport; Freshwater runoff; Alaska Current; Seasonal variations.

SYNOPSIS : Temperature and salinity sections which intersect the Alaska Current are used to determine the baroclinic, geostrophic current on 21 occasions from 1975 to 1977. A sinusoidal curve-fitting technique is applied to these Alaska Current estimates and others available in the literature to statistically test the flow for an annual signal. The mean baroclinic transport relative to 1500 db is estimated to be 9,200,000 m³/s with seasonal signal of 1,200,000 m³/s. The maximum is in March and minimum in September. Maximum speeds in excess of 100 cm/s are estimated and, typically, more than 80% of the transport is within 60 km of the shelf break. Thus, near Kodiak Island, the Alaska Current can be considered as a narrow, high speed jet. A distinctive characteristic of this and many other high-latitude baroclinic flows is that the horizontal density gradient is primarily a function of the horizontal salinity gradient, with the thermal gradient contributing to a lesser degree. For the Gulf of Alaska this salinity gradient could be created through runoff and coastal wind convergence.

ACCESS # : 317, ARL

CITATION : Schumacher, J.D., and T.H. Kinder. 1983. Low-frequency current regimes over the Bering Sea shelf. *J. Phys. Oceanogr.* 13(4): 607-623.

KEY-WORDS: Currents; Low frequency currents; Oceanography.

SYNOPSIS : Using direct current measurements made during the period 1975-81, we describe the general circulation over the southeastern Bering Sea and differentiate it by regimes related to depth and forcing mechanisms. Three regimes are present, delineated by water depth (z): the coastal (z less than or equal to 50 m), the middle shelf ($50 < z < 100$ m), and the outer shelf (z greater than or equal to 100 m). These are nearly coincident with previously described hydrographic domains. Statistically significant mean flow (1 to 100 cm/s) exists over the outer shelf, generally directed toward the northwest, but with a cross-isobath component. Flow of similar magnitude (1-6 cm/s) occurs in the coastal regime, paralleling the 50 m isobath in a counterclockwise sense around the shelf. Mean flow in the middle shelf is insignificant. Kinetic energy at frequencies < 0.5 cycle per day (cpd) is greater over the outer shelf than in the other two regimes, suggesting that oceanic forcing is important there but does not affect the remainder of the shelf. Kinetic energy in the band from 0.5 to 0.1 cpd follows a similar spatial pattern, reflecting the greater number of storms over the outer shelf. Mean flow paralleling the 100 and 50 m isobaths appears to be related to a combination of baroclinic pressure gradients (associated with frontal systems which separated the regimes) and interactions of tidal currents with bottom slopes located beneath the fronts.

ACCESS # : 318, NMFS

CITATION : Straty, R.R. 1977. Current patterns and distribution of river waters in inner Bristol Bay, Alaska. NOAA Tech. Rep. NMFS, SSRF - 713. pp. 1-13.

KEY-WORDS: Current patterns; River water distribution; Drift cards; Dye studies; Salinity-temperature distributions; Oceanography.

SYNOPSIS : Hydrographic studies to determine the distribution of the waters of the major sockeye-salmon-producing river systems in inner Bristol Bay show the net seaward flow of river water is along the northwest (right) side of inner Bristol Bay. The net motions of seawater toward the head of Bristol Bay transports with it the waters of Ugashik and Egegik rivers, which enter the bay on the southeast side. Near Egegik Bay to Middle Bluff, the mixed sea and river waters join the seaward flow of Kvichak and Naknek river waters, which enter at the head of Bristol Bay. Waters of these four rivers, along with the large volume of water from the rivers entering Nushagak Bay, are eventually transported to, and move seaward on, the northwest side of Bristol Bay. Waters of Naknek, Egegik, and Ugashik rivers are similar to each other in the courses followed during ebb and flood tides. Flood tide currents, along with the nontidal current, transport water from Egegik and Ugashik rivers above or north of the entrance to Egegik and Ugashik bays.

ACCESS #: 319, IMS-UAF

CITATION : Takenouti, A. Y., and K. Ohtani. 1974. Currents and water masses in the Bering Sea: A review of Japanese work. In: D.W. Hoot! and E.J. Kelley (eds.), Oceanography of the Bering Sea, Occ. No. 2., Inst. Mar. Sci., Univ. Alaska, Fairbanks. pp 39-57.

KEY-WORDS: Currents; Water masses; Oceanography.

SYNOPSIS : About half of the volume transport of the Alaskan Stream enters the Bering Sea through Aleutian Island passes and the rest from west of Attu Island. The highly stratified Alaskan Stream water loses its characteristic structure upon entering the Bering Sea during its first step of transformation from Eastern to Western Subarctic water. A general counterclockwise circulation and small eddies prevail in the Bering Sea. Dispersion of low-salinity shelf water in the surface layer and upwelling of deeper water associated with eddies reconstruct a stratified vertical pattern in the Bering Sea basin. This water then flows out as the East Kamchatka Current, mixing horizontally with cold low-salinity water from the Okhotsk Sea, and gradually becomes Western Subarctic in nature. The continental shelf of the eastern Bering Sea is characterized by various types of vertical temperature and salinity structures. Freshwater dilution of the surface layer, the intrusion of warm saline water near the bottom, and strong vertical mixing associated with winter cooling cause formation of dichothermal water. In regions where a conspicuous halocline is present as a barrier to winter convection activity, cold bottom water is absent.

ACCESS # : 320, ARL

CITATION : Dodimead, A.J., F. Favorite, and T. Hirano. 1963. Review of the oceanography of the Subarctic Pacific Region. International North Pacific Fisheries Commission, Vancouver, Canada. Bulletin No. 13. 195 pp.

KEY-WORDS: Oceanography; Fisheries.

SYNOPSIS : The oceanography of the Subarctic Pacific Region is reviewed with emphasis on the extensive new work accomplished since 1955 by the research organizations of the members of the International North Pacific Fisheries Commission - Canada, Japan, and the United States. Portions of the Bering Sea are included and a special appendix on the oceanography of Bristol Bay is enclosed.

ACCESS # : 321, ARL

CITATION : Cline, J., S. Katz, and H. Curl, Jr. 1981. Circulation processes in Bristol Bay, Alaska using dissolved methane as a tracer. Annual Reports of Principal Investigators for the Year Ending March 1981. pp 29-85. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Circulation; Methane tracer; Oceanography.

SYNOPSIS : The goal of this study is to utilize dissolved methane as a Lagrangian tracer of petroleum introduced from point sources in Bristol Bay, Alaska. Previous baseline studies in this area revealed the presence of localized sources of methane in Port Moller, an estuary along the North Aleutian Shelf (NAS), and in the bottom waters of St. George Basin (SGB).

ACCESS # : 322, ARL

CITATION : Baker, E.T. 1981. North Aleutian Shelf transport experiment. Annual Reports of Principal investigators for the Year Ending March 1981. Vol. VI. pp. 329-389. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Transport; Suspended particulate matter; Oceanography.

SYNOPSIS : During the present reporting period, the NASTE project was organized and two field programs (August - September, 1980, and January - February, 1981) in the southeastern Bering Sea were carried out. Only data and results from the first cruise are discussed in this report since information is not yet available from the second cruise. Data from the North Aleutian Shelf (NAS) and the St. George Basin (SGB) area showed a closer relationship between SPM (suspended particulate matter) distributions and hydrographic properties such as temperature and salinity. SPM landward of the 50 m isobath (the coastal domain) was generally well mixed throughout the water column. SPM profiles seaward of the 50 m isobath always consisted of surface and near bottom concentration maxima separated by a uniform, low concentration zone. Frontal regions were characterized by relatively low values of SPM concentration in the near bottom layer. Particle size distributions indicated that surface and near bottom SPM populations were distinct seaward of the coastal domain. Estimates of the vertical eddy diffusion coefficient made from the SPM profiles show that the bottom layer is a zone of energetic turbulent mixing capped by a thinner layer of much lower eddy diffusivity.

ACCESS #: 323, ARL

CITATION : Kinder, T.H. 1981. A perspective of physical oceanography in the Bering Sea, 1979. In: The Eastern Bering Sea Shelf: Oceanography and Resources. D.W. Hood and J.A. Calder (eds.). Vol. 1: 5-12. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Oceanography.

SYNOPSIS : Until recently, physical oceanographic research in the Bering Sea concentrated on broad spatial and long temporal scales, and much of the field work occurred off the shelf in water overlying the deep basins. Research concentrated on basin-wide phenomena of long duration, and this work determined the oceanic climate of physical geography of the Bering Sea. Since about 1975, the focus of research has shifted toward shorter spatial and temporal scales, and also from the deep basins onto the shelf. Deviations from the large-scale mean state, such as interannual variability, fronts, eddies, tides, and vertical fine structure, are important biologically as well as physically, and this trend in research will probably continue through the next decade.

ACCESS # : 324, ARL

CITATION : Overland, J.E. 1981. Marine climatology of the Bering Sea. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 1: 15-22. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Sea ice; Climatology; Oceanography.

SYNOPSIS : The climate of the Bering Sea is strongly related to the presence and movement of marginal sea ice. In winter, weather elements are continental and arctic in character, being replaced by maritime influences from the south in summer. In winter this results in north to easterly winds, a tendency for clear skies, and substantial diurnal temperature range. Summer is characterized by a progression of storms through the Bering Sea rather than fixed weather types, producing increased cloudiness, reduced diurnal temperature range, and winds rotating through the compass with a slight tendency for southwest.

ACCESS # : 325, ARL

CITATION : Niebauer, H.J. 1981. Recent short-period wintertime climatic fluctuations and their effect on sea-surface temperatures in the eastern Bering Sea. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 1: 23-30. NOAA, distrib. by Univ. Washington, Press, Seattle, WA.

KEY-WORDS: Temperatures; Climatology.

SYNOPSIS : Upper air (700 mb) winter pressure patterns have shown sharp fluctuations over the period 1963-78. Mean annual sea-surface temperature (SST) fluctuations appear to be an effect of these short-term climatic fluctuations. The mid-1960's were a time of southerly flow of air leading to above-normal SST. A rather sharp reversal in atmospheric conditions led to a sharp drop in SST in the early to middle 1970's. Since 1977, the upper air flow has become southerly, leading to a sharp rise in SST. Autocorrelation analysis of the SST suggests that these trends persist for [least two years.

ACCESS #: 326, ARL

CITATION : Kinder, T.H., and J.D. Schumacher. 1981. Hydrographic structure over the continental shelf of the southeastern Bering Sea. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol 1: 31-52. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Hydrographic structure; Domains; Oceanography.

SYNOPSIS : We synthesize recent work conducted over this exceptionally broad (500 km) shelf which generally has only slow mean flow (less than or equal to 2 cm/s). Hydrographic structure is little influenced by this flow, but rather is formed primarily by boundary processes: tidal and wind stirring; buoyancy input from insolation, surface cooling, melting, freezing, and river runoff; and lateral exchange with the bordering oceanic water mass. Three distinct hydrographic domains can be defined using vertical structure to supplement temperature and salinity criteria. Inshore of the 50 m isobath, the coastal domain is vertically homogeneous and separated from the adjacent middle domain by a narrow (10 km) front. Between the 50 m and 100 m isobaths, the middle domain tends toward a strongly stratified two-layered structure, and is separated from the adjacent outer domain by a weak front. Between the 100 m isobath and the shelf break (170 m depth), the outer domain has surface and bottom mixed layers above and below a stratified interior. This interior has pronounced fine structure, as oceanic water intrudes shoreward from the weak haline front over the slope, and shelf water (middle domain) intrudes seaward across the 100 m isobath. These domains and their bordering fronts tend to persist through winter, although the absence of positive buoyancy often makes the middle shelf vertically homogeneous.

ACCESS # : 327, ARL

CITATION : Kinder, T.H., and J.D. Schumacher. 1981. Circulation over the continental shelf of the southeastern Bering Sea. In: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 1: 53-75. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Current data; Circulation; Oceanography.

SYNOPSIS : Using extensive direct current measurements made during the period 1975-78, we describe flow over the southeastern Bering Sea shelf. Characteristics of the flow permit us to define three distinct regimes, nearly coincident with the hydrographic domains defined in the previous chapter. The coastal regime, inshore of the 50 m isobath, had a slow (1-5 cm/sec) counterclockwise mean current and occasional wind-driven pulses of a few days' duration. The middle regime, bounded by the 50 and 100 m isobaths, had insignificant (<1 cm/sec) mean flow but relatively stronger wind-driven pulses. The outer regime, between the 100 m isobath and shelf break (170 m), had a 1-5 cm/sec westward mean and low-frequency events unrelated to local winds. Over the entire shelf most of the horizontal kinetic energy was tidal, varying from 60 percent in the outer regime to 90 percent in the coastal regime. About 80 percent of the tidal energy was semidiurnal. Mean flow over the shelf is well described qualitatively by dynamic topographies, and shallow current data from coastal and outer regimes agree quantitatively as well. Two meteorological conditions that force the observed current pulses have been identified. In summer eastward-traveling low atmospheric pressure centers caused low-frequency pulses in the middle regime, and weak pulses in the coastal regime. In winter, outbreaks of cold and dry continental air forced pulses within the coastal and middle regimes.

ACCESS # : 328, ARL

CITATION : Pearson, C.A., H.O. Mofjeld, and R.B. Tripp. 1981. Tides of the eastern Bering Sea shelf. In: The Eastern Bering Sea Shelf: Oceanography and Resources. D.W. Hood and J.A. Calder (eds.). Vol. 1: 111-130. NOAA, distrib. by Univ. Washington Press, Seattle, WA.

KEY-WORDS: Tides; Oceanography; Models.

SYNOPSIS : The acquisition of a substantial amount of pressure-gauge and current-meter data on the Bering Sea shelf has permitted a much more accurate description of the tides than has previously been possible. Cotidal charts are presented for the M two and, for the first time, the N two, K one, and O one constituents, and tidal current ellipse charts for M two and K one. S one, normally the second largest semidiurnal constituent, has not been included because it is anomalously small in the Bering Sea. The tide enters the Bering Sea through the central and western Aleutian Island passes and progresses as a free wave to the shelf. Largest tidal amplitudes are found over the southeastern shelf region, especially along the Alaska Peninsula and interior Bristol Bay. Each semidiurnal tide propagates as a Kelvin wave along the Alaska Peninsula but appears to be converted on reflection in Interior Bristol Bay to a Sverdrup wave. A standing Sverdrup (Poincare) wave resulting from cooscillation in Kuskokwim Bay is evident on the outer shelf. Tidal models by Sunderman (1977) (a vertically integrated M two model of the entire Bering Sea) and by Lie and Leendertse (1978, 1979) (a three-dimensional model of the southeastern shelf incorporating the diurnal and semidiurnal tides) are discussed. Good qualitative agreement is found between the models and observation.

ACCESS # : 329, UAF

CITATION : Busdosh, M. 1981. Long-term effects of the water soluble fraction of Prudhoe Bay crude oil on survival, movement and food search success of the arctic amphipod Boeckosimus (Onisimus) affinis. Mar. Environ. Res. 5(3): 167-180.

KEY-WORDS: Oil pollution; Mortality; Sublethal effects; Amphipod; invertebrates.

SYNOPSIS : The arctic amphipod Boeckosimus (Onisimus) affinis was exposed to the water soluble fraction (WSF) of Prudhoe Bay crude oil. Animals were constantly exposed or one-time exposed for 3 or 10 days and then removed to clean water. In constant exposure experiments mortality was correlated to the strength of the solution and for 6 weeks afterwards animals in all solutions experienced similar mortality. Food search success lessened for 2 weeks, then gradually increased. Distance moved and time spent moving decreased as the concentration of the WSF increased. Animals one-time exposed to the WSF showed initial mortality rates of 15-20%, with little further mortality. Food search success was lessened relative to the strength of the WSF and duration of exposure, with general recovery within two weeks. Distance moved was decreased, but time spent moving was not. The overall period of testing was four months.

ACCESS # : 330, ARL

CITATION : Burrell, D.C. 1979. Distribution and dynamics of heavy metals in Alaskan shelf environments subject to oil development. Annual Reports of Principal investigators for the Year Ending March 1979. Vol. 5. pp. 26-546. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Heavy metals; Oil pollution; Estuaries; Toxicity.

SYNOPSIS : The baseline work was completed in the Beaufort Sea and in Cook Inlet during the current 1978-79 contract period. The primary objective of this program is to research natural pathways of potentially toxic heavy metals to and through Alaskan shelf and coastal biota (with emphasis on commercially important benthic species), and hence to determine and predict changes likely to result from oil industry activity. Ancillary components include; (1) characterizing the heavy metal inventories of the water, sediment and indigenous biota in those geographical areas for which no background data exist, (2) determining non-biological pathways (rates and routes under both natural and stressed conditions) of the heavy metals as these affect the availability of metals to the organisms, and (3) toxicity effects of selected heavy metals to animals which are of major commercial importance under Alaskan environmental conditions. Apart from some continuing baseline survey work, this program addresses basic problems in heavy metal cycling in estuarine and nearshore areas. The work is an essential prerequisite to an understanding of the changes likely to be induced in the natural system by thorough, large scale energy development impingements.

ACCESS # : 331, ARL

CITATION : Burrell, D.C. 1977. Natural distribution of trace heavy metals and environmental background in Alaskan shelf and estuarine areas. Principal Investigators' Reports for the Year Ending March 1977. Vol. 13. pp. 290-506. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Heavy metals; Toxicity; Benthos; Sediments.

SYNOPSIS : The scope of this project included lower Cook Inlet, Norton Sound and the southern part of the Chukchi Sea in addition to the three shelf areas (Gulf of Alaska, Bering, and Beaufort Seas). Baseline collection and analysis of water column samples is now considered to be complete. For the soluble contents analysed to date, Cd, Pb, Cu, Ni, Fe, and V concentrations in filtered seawater from all shelf regions of Alaska are generally lower than commonly accepted oceanic means. As expected for such open ocean areas, distributions are quite uniform. Surficial sediment samples, collected in a uniform, contamination-free fashion in all these areas, show a number of heavy metals have been determined both as concentrations in extractable fractions from the sediment surface and as "whole rock" totals. In all cases the heavy metal contents are a function of the sediment grain size fractionation and the lithology. The concentrations of particulate heavy metals in the water are related to the particulate sediment load with enhanced concentrations adjacent to the sediment interface and in coastal waters. The clay mineralogy of all the fine grained fractions have also been determined. A fairly representative spread of two intertidal benthic species have been analysed. Data show heavy metal contents as low or lower than other regions. It is noted that the Alaskan shelf regions could well serve as a type example of pristine coastal environments.

ACCESS # : 332, ARL

CITATION : Barton, L.H. 1979. Finfish resource surveys in Norton Sound and Kotzebue Sound. Final Reports of Principal Investigators. Vol. 4. pp. 75- 313. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Fishes; Oil pollution; Petroleum development; Fisheries; Yukon Delta.

SYNOPSIS : An evaluation of the subsistence use of Pacific herring and other fishery resources to coastal residents in Norton Sound and Kotzebue Sound is given. Contamination of important spawning, rearing, and/or overwintering areas from petroleum related activities could destroy one or more year classes, resulting in either a general weakening and decline in populations or possible elimination of an entire population, depending upon the severity and extent of pollution. Some concerns related to petroleum exploration and development and the potential impact of oil spills on the fishery resources throughout the study area are discussed. A major concern is the absence of data on distribution, relative abundance, range, age structure, etc. of fishery resources during the ice covered months. A second concern is the lack of information available on fishery resources which utilize the Yukon River Delta. This is considered as possibly the single most important ecosystem in the area and potentially the most vulnerable to disruption from either acute or chronic pollution problems. The deep water harbor of Port Clarence is also discussed as an area where further studies are needed to ensure proper planning and development of petroleum related activities in this area.

ACCESS # : 333, ARL

CITATION : Craddock, D.R. 1977. Acute toxic effects of petroleum on arctic and subarctic marine organisms. In: D.C. Malins (ed.), Effects of petroleum on arctic and subarctic marine environments and organisms. Vol. 2. Academic Press, New York, NY. pp. 1-93

KEY-WORDS: Toxicity tests; Oil pollution.

SYNOPSIS : The objectives of this chapter are to review the literature on acute toxicity bioassay techniques using aquatic (mainly marine) organisms and to review the results of bioassays of petroleum relative to the toxicity of the various products tested and the sensitivity of the various marine organisms used (mainly arctic and subarctic species).

ACCESS # : 334, ARL

CITATION : Busdosh, M., K.R. Debra, A. Horowitz, and S.E. Neff et al. 1978. Potential long-term effects of Prudhoe Bay crude oil in arctic sediments on indigenous benthic invertebrate communities. Proc. Conf. Assess. Ecol. impacts Oil Spills, 14-17 June 1978. Am. Inst. Biol. Sci. pp. 856-874.

KEY-WORDS: Sediment; Benthos; Oil pollution; Toxicity.

SYNOPSIS : Laboratory and field experiments were performed to determine the potential toxicity of Prudhoe Bay crude oil to indigenous arctic benthic invertebrates. Toxicity was measured as mortality and as sublethal behavioral changes in feeding, movement and burrowing activities. When sediment was contaminated with fresh Prudhoe Bay crude oil, burrowing activity of the amphipod Boeckosimus (Onisimus) affinis was significantly reduced. Weathering of the oil was monitored by gas-liquid chromatography. Given a choice, in laboratory studies with oil contaminated or uncontaminated sediment, the amphipods selectively burrowed into the uncontaminated sediment. The preference for burrowing in oiled substrate appears to be reflected in the avoidance of oil contaminated sediment in benthic community studies.

ACCESS # : 335, ARL

CITATION : Dunn, J.R., A.W. Kendall Jr., R.W. Wolotira, L. Quetin, and J.H. Bowerman. 1979. Seasonal composition and food web relationships of marine organisms in the nearshore zone. Principal Investigators' Reports for the Year Ending March 1979. Vol. VI. pp. 456-528. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Zooplankton; Food web; Fish; Oil pollution; Petroleum development.

SYNOPSIS : A field program was designed to elucidate the distribution in time and space of the zooplankton (both holo- and meroplankton) of continental shelf waters contiguous to Kodiak Island. These planktonic forms are of vital importance to the marine food web of the area, not only as food for higher trophic levels, but because most finfish and shellfish of the area spend critical early parts of their life histories as members of the plankton community. Prior to this study, virtually nothing was known about the specific composition and abundance of the zooplankton community, nor was the seasonal occurrence and areal distribution of larval forms of species contributing to the fisheries of the area known. With the knowledge of these distributions, the effects of chronic or catastrophic impacts of petroleum development can be evaluated. Certain areas and seasons may be more critical than others to the success of year classes as they pass through their planktonic phase.

ACCESS # : 336, ARL

CITATION : Drury, W.H., and J.O. Biderman. 1978. Ecological studies in the northern Bering Sea: studies of seabirds in the Bering Strait. Principal Investigators' Reports for the Year Ending March 1978. Vol. II. pp. 751-838. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Disturbance; Ecology; Bering Strait; Petroleum transport; Seabirds.

SYNOPSIS : In the area between Cape Lisburne and Saint Lawrence Island there are 3,725,000 to 4,000,000 seabirds. Little Diomedes Island, the subject of this study, is a major seabird colony and the northern-most nesting colony of Parakeet, Crested and Least Auklets. Drastic population reduction or steady declines are possible results of development. It has been suggested that populations be reduced at experimental colonies in order to establish the rate of recovery. It is generally believed that arctic birds are subjected to stress by the extra effort required for breeding. Any further stress introduced by the impacts of development upon their food sources are likely to cause some degree of reproductive failure. An important aspect of OCSEAP is defining differences in biological oceanographic structures of the Bering Sea. Disturbance by the chronic effects of through traffic, by secondary effects such as helicopter operations and coastal development, by direct damage from oil spills or by indirect effects on the food of the seabirds will affect an area that is comparable to the plains of East Africa among the major natural wonders of the world.

ACCESS # : 337, ARL

CITATION : Devries, A.L. 1977. The physiological effects of acute and chronic exposure to hydrocarbons on near-shore fishes of the Bering Sea. Principal investigators Reports for the Year Ending March 1977. Vol. 12. pp. 7-22. OCSEAP/NOAA, Boulder, CO .

KEY-WORDS: Hydrocarbons; Oil pollution; Fishes.

SYNOPSIS : The main objective was to establish the effect of selected petroleum hydrocarbons on the physiology of certain cold-water fishes that are year round residents of the Bering Sea. Sculpins from the Bering Sea were shown to take up naphthalene from their environment, however it appeared to have little effect on the biosynthesis of either the plasma protein or of the peptide antifreeze. Morphological studies demonstrated that naphthalene exposure caused deterioration of the liver, however it was not determined whether this was a direct effect of naphthalene metabolism or resulted indirectly from anemia and reduced food intake. The normal rate of protein synthesis in the naphthalene exposed fishes suggests that compensatory mechanisms exist to maintain a constant synthetic rate of liver proteins.

ACCESS # : 338, ARL

CITATION : Devries, A.L. 1976. The physiological effect of acute and chronic exposure to hydrocarbons of petroleum on the near-shore fishes of the Bering Sea. Principal Investigators' Reports for the Year Ending March 1976. Vol. 8. pp. 1-14. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Toxicity; Oil pollution; Sculpins; Fishes; Physiology.

SYNOPSIS : Toxicity data for exposure to water soluble hydrocarbons on a few Bering Sea fishes are presented. The temperature of exposure appears to have profound effects. At low temperatures the hydrocarbons appear to be less toxic. Baseline measurements of oxygen consumption both at the organismal and tissue level reveal that the Bering Sea fishes are similar to other cold water fishes in regards to their physiology. Studies of the levels of freezing resistance in sculpin indicated that it is a seasonal phenomenon. The time course of the appearance and disappearance of freezing resistance indicate that this system will be a good model for studying the effect of naphthalene on antifreeze synthesis.

ACCESS # : 339, ARL

CITATION : Dames and Moore. 1979. Ecological studies of Intertidal and shallow subtidal habitats in Lower Cook Inlet. Principal investigators! Reports for the Year Ending March 1979. Voi. IV. pp. 1-275. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Littoral habitats; Oil pollution; Petroleum development; Cook Inlet; Ecology.

SYNOPSIS : Field studies were initiated in intertidal and shallow subtidal habitats in Lower Cook Inlet to examine species composition, zonation and seasonal patterns, trophic structure, rates of production and energy pathways. Habitats examined included rocky intertidal and subtidal areas, sand beaches and mudflats. The two major potential types of oil pollution of concern in Lower Cook Inlet are catastrophic spills of crude oil and chronic pollution by refined petroleum or refinery effluents. Chronic pollution is a concern chiefly on the eastern shore of the Inlet since most onshore facilities are planned for that side. A regional assessment of coastal morphology has been used to predict behavior of oil spills in Lower Cook Inlet and to develop a classification of the susceptibility of local coastal environments to oil spills. This classification is based primarily on geological features and sediment characteristics as they relate to interactions with crude oil. It provides a useful starting point in assessing potential impacts from oil pollution, but it is necessary to temper the assessments with the idea that the major incentive for investigating potential effects of oil pollution is protection of biological assemblages. A point sometimes overlooked is that a ranking of biological assemblages by either importance or susceptibility to oil pollution does not always agree closely with the classification based on geological characteristics. Several factors must be integrated to develop a satisfactory assessment of susceptibility.

ACCESS # : 340, ARL

CITATION : Costa, D.P. and G.L. Kooyman. 1981. Effects of oil contamination in the sea otter, Enhydra lutris. Final Reports of principal investigators. Voi. 10. pp. 65-108. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Sea otter; Oil pollution; Physiology; Metabolism; Marine mammals.

SYNOPSIS : The objective of this study was to measure effects of crude oil contamination on sea otters through studies on the changes in the animal's physiology and behavior before and after contact with oil. A second objective was to attempt to rehabilitate the otters after crude oil contamination. The study has shown that small amounts of crude oil contamination have large effects on the metabolic rate of sea otters. Light oiling of approximately 25% of the animal's pelt surface area resulted in a 1.4X increase in metabolic rate while immersed in water at 15 degrees C. Furthermore, when the oil was removed by detergent, the animal's metabolic rate increase 2.1X while immersed in water at 15 degrees C. Of the three animals studied, two contracted pneumonia and one died. Studies upon free ranging sea otters have established that under certain conditions, sea otters can sustain low levels of oil contamination when 20% or less of the body surface is oiled.

ACCESS # : 341, ARL

CITATION : Cline, J., C. Katz and A. Young. 1979. Distribution and abundance of low molecular weight hydrocarbons and suspended hydrocarbons in Cook Inlet, Alaska. Annual Reports for the Year Ending March 1979. Vol. V. pp. 264-325. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Aromatic compounds; Toxicity; Oil pollution; Cook Inlet; Hydrocarbons; Petroleum development.

SYNOPSIS : During the past two years, emphasis has shifted toward sources of low molecular weight (LMW) hydrocarbons in Cook Inlet, including both natural and anthropogenic sources. Special attention has been devoted to sources of LMW aromatics in upper Cook Inlet and the fate of these compounds. Specialized studies in Cook Inlet have continued on the air-sea exchange of LMWH and in-situ production of gases in both the water column and from the underlying sediments. These data provide necessary information for the identification and sources of petroleum-like hydrocarbons in the waters of Cook Inlet. These studies were enacted to characterize the dissolved LMW natural hydrocarbons in Cook Inlet, Alaska. The purpose was to establish concentration levels and temporal and spatial variability of hydrocarbon components common to petroleum or natural gases resources prior to actual production. These measurements were felt to be an invaluable precursor to future monitoring efforts. The principal concern surrounding the distributions, sources, and sinks of LMWH is not their direct impact on biota, but rather their role as tracers of more toxic hydrocarbon fractions commonly found in crude oils. The principal goal is to provide the criteria for an early warning detection of petroleum-derived hydrocarbons and to establish the feasibility of using light hydrocarbons as tracers, particularly in reference to near-bottom mixing and resuspension processes.

ACCESS # : 342, PMEL

CITATION : Cline, J., T. Bates and C. Katz. 1980. Distribution and abundance of low molecular weight hydrocarbons and suspended hydrocarbons in Cook Inlet, Shelikof Strait, and Norton Sound, Alaska. Annual Reports of Principal investigators for the Year Ending March 1980. Vol. 3. pp. 192-272. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Petroleum; Suspended organic matter; Dissolved organic matter.

SYNOPSIS : These studies were enacted to characterize the dissolved low molecular weight (LMW) natural hydrocarbons in Cook Inlet, Shelikof Strait, and Norton Sound, Alaska. The purpose was to establish concentration levels and temporal and spatial variability of hydrocarbon components common to petroleum or natural gas resources prior to actual production. Examination of data indicates that the LMWH will be excellent tracers of petroleum or natural gas input in all of the Alaska OCS areas. Studies to date also have revealed useful compositional parameters for distinguishing hydrocarbon sources. The most valuable of these is the ethane: ethene and propane: propene ratios. The low abundance of the aliphatic unsaturates in crude oil coupled with low production of alkanes by biological systems gives an unequivocal indicator of fossil gas and oil sources. Investigation in upper Cook Inlet have shown that dissolved LMW aromatics may be useful indicators of petroleum and refined products. These compounds are unique to crude oil and apparently are not produced by marine biological systems. Because of the low ambient levels found in pristine marine environments, such as Alaska, these compounds should provide a sensitive and reliable measure of chronic spillage.

ACCESS # : 343, PMEL

CITATION : Cline, J. 1977. Distribution of light hydrocarbons, C1-C4, in the northeast Gulf of Alaska, lower Cook Inlet, southeastern Bering Shelf, Norton Sound and southeastern Chukchi Sea. Annual Reports of Principal Investigators. vol. 13. pp. 180-268. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Hydrocarbons; Marine biology; Oil pollution.

SYNOPSIS : The development of petroleum resources in the Gulf of Alaska may result in the release of toxic hydrocarbons to the marine environment with possible deleterious effects on the pelagic, benthic, and intertidal biota. It is of environmental significance that baseline levels of both naturally occurring and petroleum-derived hydrocarbons be established prior to the development of fossil fuel resources in the area. Low molecular weight hydrocarbon (LMWH) studies were carried out in the northeast Gulf of Alaska and the southeastern Bering Sea to determine the distributions and natural sources of methane, ethane, ethylene, propane, propylene, isobutane and n-butane. Known offshore seeps were investigated to ascertain the composition of natural gas seeps and to evaluate the merits of naturally injected LMWH as tracers of petroleum input. Baseline surveys have been completed in the northeast Gulf of Alaska, southeastern Bering Sea, Norton Sound, and southeastern Chukchi Sea. The data obtained to date is probably sufficient to delineate the background levels of the low molecular weight aliphatic hydrocarbons to be expected in a future monitoring activity.

ACCESS # : 344, ARL

CITATION : Clark, R.C. Jr. 1979. Levels and sources of critical trace metals in the marine environment. Final Reports of Principal investigators. Vol. 5. pp. 5-51. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Water pollution; Petroleum; Trace metals.

SYNOPSIS : Some of the elements in petroleum are also found in seawater where they range in concentration from a few percent to parts per trillion. The ecological aspects, or effects, of these elements may range from beneficial (essential) to detrimental (toxic). Any assessment of the biological effects of trace metals from petroleum on the marine environment must consider the levels of these elements in petroleum, drilling chemicals and production (brine) waters, the levels naturally present in seawater, the chemical form of the metals, and the reactivity and toxicity of the chemical forms of the metals. There are six trace metals, namely, chromium, nickel, copper, cadmium, mercury, and lead which occur in petroleum at trace levels and are toxic to at least some marine organisms at such levels. In view of their potential impact on the arctic and subarctic marine environments, these metals are considered in this report.

ACCESS # : 345, ARL

CITATION : Becker, P.R. 1979. Contaminants and environmental disturbances that may accompany petroleum exploration and development. Lower Cook Inlet interim Synthesis Report. pp. 27-47. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Oil pollution; Oil spills; Petroleum development; Disturbance; Cook Inlet.

SYNOPSIS : Oil and gas production has occurred in the upper portion of Cook Inlet (above the Forelands) for about the last ten years, and onshore development has occurred just below the Forelands at Nikiski and Drift River. Information resulting from Cook Inlet's history of OCS development and applied engineering operations can provide more accurate projections of the effects of future OCS development in Lower Cook Inlet. Potential sources of hydrocarbons and associated contaminants are the off-shore platforms, pipelines, shore facilities including tanker terminals, tankers and chemicals that might be employed in the cleanup if an oil spill occurred. Considering the history of oil spills in other geographical areas and the locations of the leased blocks in Lower Cook Inlet, it is probable that the most damaging effect of platforms would come from large-volume acute spill from fires or blow-outs. It is believed that low-volume spills would be dispersed fairly rapidly by the strong currents in the central lower Inlet. An important potential result of construction or expansion of onshore facilities is permanent habitat destruction through filling of subtidal areas and maintenance dredging. This could be catastrophic to biological populations both locally and regionally. A potential result of petroleum exploitation in Lower Cook Inlet is an increase in tanker traffic.

ACCESS # : 346, ARL

CITATION : Burrell, D.C. 1978. Distribution and dynamics of heavy metals in Alaskan shelf environments subject to oil development. Quarterly Report for April-June 1978. pp. 170-200, OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Heavy metals; Benthos; Pollution effects.

SYNOPSIS : Natural pathways of potentially toxic heavy metals to and through Alaskan Shelf and coastal marine biota (with emphasis on commercially important benthic species) are researched to determine and predict changes likely to result from oil industry activity in this marine zone. Ancillary components of this work include; (1) characterizing the heavy metal inventories of the water, sediment, and indigenous biota in those geographic areas for which no background data exist, (2) determining non-biological pathways (rates and routes under both natural and stressed conditions) of heavy metals as these affect the availability of metals to the organisms, and (3) toxicity effects of selected heavy metals to animals which are of major commercial importance under Alaskan environmental conditions.

ACCESS # : 347, IMS-UAF

CITATION : Brocksen, R.W. and H.T. Bailey. 1973. Respiratory response of juvenile chinook salmon and striped bass exposed to benzene, a water-soluble component of crude oil. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills. March 13-15, 1973. Washington, D.C.

KEY-WORDS: Oil spills; Fish; Aromatic hydrocarbons; Salmon.

SYNOPSIS : Interest surrounding the potential effects of crude oil on aquatic organisms has increased in recent years due to the incidence of accidental oil spills. There are few experimental results reported, however, dealing with the effect on aquatic species of water-soluble aromatic hydrocarbons contained in crude oil. Such compounds are highly toxic to mammals. Experiments were conducted using juvenile chinook salmon, Oncorhynchus tshawytscha, and striped bass, Morone saxatilis. The fish were exposed to sub-lethal concentrations of the aromatic hydrocarbon benzene, for periods ranging from 1-96 hours. Prior to exposure and after exposure to the benzene, respiration rates of individual fish were measured. Results show increases in respiratory rate up to 115 percent above that of control fish after exposure periods of 24 hours for striped bass and 48 hours for chinook salmon. Fish exposed to benzene concentrations of 10 ppm for periods longer than those listed exhibited a narcosis that caused a decrease in respiratory rate. The narcotic state induced by exposure to benzene was shown to be reversible when the fish were placed in fresh water and kept for periods longer than 6 days. Possible biochemical mechanisms leading to this response are hypothesized.

ATTACHMENT :

ACCESS # : 348, ARL

CITATION : Atlas, R.M. 1979. Fate and effects of oil pollutants in extremely cold marine environments. Final Report, Contract No. N00014-76-C-0400, Task No. Nr 205-013. Office of Naval Research. pp. 80.

KEY-WORDS: Oil pollution; Ecosystems; Weathering; Oil spills; Marine pollution; Hydrocarbons; Benthos.

SYNOPSIS : Studies were conducted on the fate and effects of crude and refined oils in arctic ecosystems. Major conclusions of the study were: (1) microbial populations respond rapidly to an introduction of hydrocarbons into the environment by an increase of the number of hydrocarbons utilizing bacteria and a decrease in species diversity (2) hydrocarbons will remain in arctic ecosystems for prolonged periods following contamination. Following initial abiotic weathering, biodegradation occurs slowly. The fate depends on the particular ecosystem that is contaminated. Refined oil spillages may contaminate drinking water supplies for long periods of time (3) hydrocarbon biodegradation in the arctic is limited mainly by low temperatures. Hydrocarbon utilizing microorganisms are widely distributed (4) when crude oil is exposed on water, biodegradation reduces absolute amounts of petroleum hydrocarbons, but does not appear to alter the relative percentages of oil components. This appears to be major difference between petroleum biodegradation in the arctic and in temperate regions and (5) petroleum contamination of arctic sediments will result in alterations of the benthic community. Petroleum exhibits differential toxicity to benthic invertebrates.

ACCESS # : 349, ARL

CITATION : Environmental Research Laboratories. 1976. Environmental Assessment of the Alaskan Continental Shelf. Quarterly Report of Principal Investigators. PP. 898. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Pollution effects; Oil pollution; Toxicity; Chemistry; Microbiology; Sea Ice; Oceanography.

SYNOPSIS : This volume contains the quarterly reports of baseline studies on the environmental effects of the development of resources on the Alaska continental shelf. Baseline studies encompass pollution effects, chemistry and microbiology, physical oceanography geology, ice and data management.

ACCESS # : 350, ARL

CITATION : Environmental Research Laboratories. 1976. Environmental Assessment of the Alaskan Continental Shelf. Principal Investigators' Reports for the Year Ending March 1976. Vol. 8. Effects of Contaminants. pp. 392. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Toxicity; Oil pollution; Photosynthesis; Ecology; Distributions; Ecosystems; Fishes; Marine mammals; Eelgrass; Crabs; Crustacea.

SYNOPSIS : This is the 8th volume of a set of 14 which present baseline studies of the natural resources of the Alaska Continental Shelf as well as studies of the environmental effects of the development of the resources in that area with effects of the development of the resources in that area with particular emphasis on oil pollution. This volume contains the following studies: The Physiological effect of acute and chronic exposure to hydrocarbons and of petroleum on the near-shore fishes of the Bering Sea; Physiological impact of oil on Pinnipeds; Acute and chronic toxicity, uptake, and depuration and sublethal metabolic response of Alaskan marine organisms to petroleum hydrocarbons; Sublethal effects as reflected by morphological, chemical physiological, and behavioral indices; Identification of major processes in biotransformation of petroleum hydrocarbons and trace metals on biota in arctic and subarctic waters; Acute effects-Pacific Herring Roe in Gulf of Alaska; Acute and chronic toxicity of sea-water extracts of Alaskan crude oil to zoeae of the dungeness crab, Cancer magister Dana; And sublethal effects - effects on seagrass photosynthesis.

ACCESS # : 351, ARL

CITATION : Environmental Research Laboratories. 1977. Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of principal Investigators for the Year Ending March 1977. Vol. XII. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Heavy metals; Ecology; Ecosystems; Petroleum development.

SYNOPSIS : Reports containing baseline studies are compiled in this annual report. They are intended to serve as markers or as points of departure from which to assess the potential environmental impact that might result from resources development on the Alaskan Continental Shelf. This compilation contains the following studies: The physiological effects of acute and chronic exposure to hydrocarbons on near shore fishes of the Bering Sea; Lethal and sublethal effects on selected Alaskan Maine species after acute and long-term exposure to oil and oil components; Sublethal effects of petroleum hydrocarbons and trace metals, including biotransformations, ecosystem dynamics, Eastern Bering Sea; ecosystem dynamics birds and marine mammals, Part I and Part II.; Effects of petroleum exposure on hatching success and incubation behavior of Glaucous-winged Gulls; Evolution, pathobiology and breeding ecology of the Gulf of Alaska Herring Gull group; Acute effects - Pacific Herring Roe in the Gulf of Alaska; Sublethal effects on seagrass photosynthesis; transport, retention, and effects of the water-soluble fraction of Cook Inlet crude oil; And research to determine the accumulation of organic constituents and heavy metals from petroleum-impacted sediments.

ACCESS # : 352, ARL

CITATION : Environmental Research Laboratories. 1978. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Vol. 1. Biological Studies. pp. 490. OCSEAP/NOAA.

KEY-WORDS: Oil pollution; Water pollution; Hydrocarbons; Plankton; Fish; Invertebrates; Birds.

SYNOPSIS : Seven final reports on baseline studies of the aquatic fauna and ecology of the Alaskan Continental Shelf which assess the environmental effects of petroleum developments in that area are compiled in this volume. Titles are: Lethal and sublethal effects on selected Alaskan marine species after acute and long-term exposure to oil and oil components; Food and feeding relationships in the benthic and demersal fishes of the Gulf of Alaska and Bering Sea; A review of the literature and a selected bibliography of published and unpublished literature on marine birds of Alaska; Determination and description of knowledge of the distribution, abundance, and timing of salmonids in the Gulf of Alaska and Bering Sea; Ichthyoplankton of the Eastern Bering Sea; Zooplankton and Micronekton; And Trawl survey of the epifaunal invertebrates of Norton Sound, Southeastern Chukchi Sea, and Kotzebue Sound.

ACCESS # : 353, ARL

CITATION : Alaska Sea Grant Program. 1978. Ocean Pollution Research Program. Alaska Regional Workshop, Final Report. Anchorage, Ak. pp. 103.

KEY-WORDS: Marine biology; Sea ice; Oil pollution.

SYNOPSIS : Participants at the conference emphasized the need for long-term work on the effects of low-level, chronic pollution, multi-disciplinary process oriented research at the community-ecosystem level and innovative approaches to the detection of subtle changes in the biological condition of species and major deleterious impacts on the indigenous biota. Other high priorities were concerned with transportation (mainly oil pollution), and fish processing and urban liquid wastes. The immense size of Alaska means that a wide spectrum of climatic and physical coastal and shelf environments are represented, each with a range of dominant pollution activities. The format of the conference recognized this by designating a series of "ecosystem" working groups such as: ice-covered waters Arctic coastal lagoons (and shallow embayments) major river deltas and plume impact areas, high-productivity shelf areas (major benthic and pelagic fishing grounds) and fjords, estuaries and confined coastal waters. Each group considered impact and associated information needs by geographical regions as follows: Gulf of Alaska, Bering Sea, and Arctic (i.e. Chukchi and Beaufort Seas).

ACCESS # : 354, RAS-UAF

CITATION : Aarset, A.V. and K.E. Zachariassen. 1982. Effects of oil pollution on the freezing tolerance and solute concentration of the blue mussel *Mytilus edulis*. Mar. Biol. 72: 45-51.

KEY-WORDS: Bivalves; Oil pollution; Temperature

SYNOPSIS : The purpose of the present study has been to investigate to what extent oil affects the intracellular concentrations of free amino acids in *Mytilus edulis*, and thus the ability of these mussels to tolerate cold exposure at low tide in winter. The study was carried out in the laboratory by exposing *M. edulis* mussels to oil-mixed sea water and observing the effects on their cold-hardiness and the concentrations of free amino acids in the body fluid compartments. The values for oil-polluted mussels have been compared with corresponding values of controls kept in oil-free sea water.

ACCESS # : 355, RAS-UAF

CITATION : Anderson, J.W., E.A.Crecellius, D.L. Woodruff and J.M. Augenfeld. 1980. Uptake of trace metals by the clam *Macoma inquinata* from clean and oil-contaminated detritus. Bull. of Environ. Containⁿ. and Toxicol. 25, No.3. pp. 337-344.

KEY-WORDS: Hydrocarbons; Sediments toxicity; Heavy metals; Oil pollution. Bivalves; Feeding behavior.

SYNOPSIS : A detritivorous clam, *Macoma inquinata*, was exposed to clean and Prudhoe Bay crude oil-contaminated detritus to determine the effect of oil on radiolabelled metal accumulation (Cr, Co, Eu, Fe, Sc, Zn). There was no evidence to suggest that exposure to 1000 ppm petroleum hydrocarbon either increased or decreased the rate at which the clam absorbs the metals, other than through a decrease in the rate of food intake. Crude oil in sediment might affect the condition of the clams through an effect on feeding behaviour, but an increased risk of heavy metal toxicity to the clam population was unlikely. Nevertheless, oil contamination could alter patterns of metal transfer in the marine benthic community and change the food web, owing to changes in the feeding behaviour.

ACCESS # : 356, ARL

CITATION : Anderson, J.W., S.L. Kfesser and J.W. Blaylock. 1979. Comparative uptake of Naphthalenes from water and oiled sediment by benthic amphipods. In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup). March 19-22, 1979. Los Angeles, Ca.

KEY-WORDS: Amphipods; Oil pollution; Sediments; Aromatic hydrocarbons; Benthos.

SYNOPSIS : The benthic amphipod, *Anonyx latiroxae*, was exposed to whole oil on sediments or water extracts of Prudhoe Bay crude oil under both static and flowing conditions. Time periods of exposure ranged from 4 to 27 days and, while a range of compounds was present, the only class measured in water, tissues, and sediments was naphthalenes. Sediment exposures demonstrated relatively low bioavailability of naphthalenes and the route of entry appeared to be via interstitial and water column contamination. It appears that release of naphthalenes from both oiled sediment and tissues is largely controlled by water solubilities of the components, but metabolic processes may supplement this activity.

ACCESS # : 357, RAS-UAF

CITATION : Albers, P.H. 1979. Effects of Corexit 9527 on the hatchability of mallard eggs. Bull. Environ. Contain. Toxicol. 23: 661-668.

KEY-WORDS: Toxicity; Mortality; Oil pollution; Waterfowl.

SYNOPSIS : The paper reports the results of a study of the effects of Corexit 9527 dispersant, crude oil, and crude oil/Corexit 9527 mixtures on mallard duck (*Anas platyrhynchos*) embryos. Groups of eggs were treated with either 1, 5, or 20 ul of Prudhoe Bay (Alaska) crude oil, Corexit 9527, a 30:1 oil/Corexit mixture or 5:1 oil/Corexit mixture. Mallard eggs treated with 20 ul of crude oil, Corexit 9527, 30:1 oil/Corexit 9527, 5:1 9527 had significantly lower hatching success than the untreated control eggs. The comparisons between treated groups and the control and among treated groups were used to create a general toxicity ranking: (Corexit 9527=5:1 oil/Corexit 9527) Prudhoe Bay crude oil 30:1/Corexit 9527. Corexit 9527 appeared to penetrate egg shells and shell membranes as readily as crude oil. No gross external malformations or behavioral abnormalities were observed.

ACCESS # : 358, RAS-UAF

CITATION : Anon. 1971. Water pollution as a world problem: the legal, scientific and political aspects. Europa Publications, London. pp. 248.

KEY-WORDS: Wetlands; Toxicity; Nutrients; Pollution effects.

SYNOPSIS : Papers presented at a conference convened by the David Davies Memorial Institute of International Studies and the Dept. of International Politics of the Univ. College of Wales in July 1970, considered the nature and control of pollution arising from discharges to sea and inland waters of radioactive materials, oil, organic effluents, plant nutrients, toxic substances including pesticides, sewage, and trade waste waters. The value of international control measures, where applicable, was stressed. The book includes the discussion which followed each session, and texts are appended of the Canadian Arctic Waters Pollution Bill and the Convention on Wetlands of international importance.

ACCESS # : 359, ARL

CITATION : Caldwell, R.S., E.M.Caldarone and M.H.Mallon. 1976. Effects of a seawater-soluble fraction of Alaskan crude oil and its major aromatic components on larval stages of the dungeness crab, *Cancer magister* (Dana). principal Investigator Reports for October-December 1976. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Crustacea; Crabs; Petroleum; Oil Pollution; Toxicity.

SYNOPSIS : Larval stages of the Dungeness crab, *Cancer magister* (Dana), were exposed continuously to dilutions of Alaskan crude oil water-soluble fraction (WSF) or seawater solutions of naphthalene or benzene for periods lasting up to 60 days. Effects on survival, duration of larval development and size were employed as indicators of toxic effects. By these criteria the toxic threshold for exposure to the WSF was estimated as 4.0% of the full strength WSF (0.0049 mg/l as naphthalene or 0.22 mg/l as total dissolved aromatics). The lowest concentration at which toxic effects were observed with naphthalene was 0.13 mg/l and with benzene was 1.1 mg/l. The concentrations of aromatic hydrocarbons in the WSF were inversely related to the degree of alkylation in each of the benzene and naphthalene families, but the acute toxicity of the 12 compounds was directly related to the degree of alkyl-benzene and its derivatives. Because of these relationship, the individual aromatic compounds, contributed approximately equally to the acute toxicity of the WSF. The collective toxicity of these compounds tested individually accounted for only 8.45% of the WSF acute toxicity. Since benzene contributed a greater fraction of the WSF of this compound may involve a different mechanism in long term exposures than in acute tests.

ACCESS # : 360, IMS-UAF

CITATION : Blaylock, J.W., S.E. Miller, B.L.Olla, and W. H. Pearson. 1981. Detection of the water-soluble fraction of crude oil by the blue crab, *Callinectes sapidus*. Mar. Environ. Res. 5(1): 3-11.

KEY-WORDS: Crabs; Hydrocarbons; Oil pollution; Temperature.

SYNOPSIS : Blue crabs exposed to a water-soluble fraction of Prudhoe Bay crude oil abruptly changed antennular orientation, began rhythmic beating of the maxillipedal flagellae, and increased antennular flicking rate. They were more sensitive than the Dungeness crab, *Cancer magister*, but this may be temperature dependent. The blue crab can readily detect petroleum hydrocarbons at concentrations found in chronically polluted areas, as well as oil spills.

ACCESS # : 361, ARL

CITATION : Cheatham, D.L., R.S. McMahon, S.J. Way, and J.W. Short. 1977. The relative importance of evaporation and biodegradation and the effect of lower temperature on the loss of some mononuclear and dinuclear aromatic hydrocarbons from seawater. Principal investigators Reports for the Year Ending March 1977. Vol. 12. pp. 44-65. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Toxicity; Oil pollution; Temperature; Cook Inlet; Hydrocarbons.

SYNOPSIS : A Cook Inlet crude oil water-soluble fraction, incubated at 5 degrees, 8 degrees, and 12 degrees C. was analyzed by *gas* chromatography during a 96-h period to determine the effect of temperature on evaporation and biodegradation of individual mononuclear and dinuclear aromatic hydrocarbons in seawater. The relative importance of evaporation and biodegradation on the loss of these hydrocarbons was assessed at each temperature using combinations of aeration and poison as experimental conditions. Lower temperature reduced the loss of mononuclear and dinuclear aromatic hydrocarbons from seawater. Evaporation was an especially significant factor in the loss of mononuclear aromatics, but had a significant effect on dinuclear aromatics, particularly naphthalene. Natural means exist for eliminating toxicity for longer periods of time at lower temperatures, because aromatic hydrocarbons would persist in seawater longer.

ACCESS # : 362, ARL

CITATION : Craddock, D.A. 1979. Acute toxicity of heavy metals. Final Reports of Principal Investigators. Vol. 5. pp. 52-81. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Toxicity; Heavy metals; Pollution effects; Petroleum development.

SYNOPSIS : The toxic effects of heavy metals on marine species and more specifically of the effect on arctic and subarctic species were studied. The metals that were considered are four important metals associated with the production of petroleum: cadmium, chromium, nickel, and lead. Heavy metals in solution in seawater affect marine organisms mainly by adsorption. Adsorption may occur across the general body surfaces and through special structures such as gills, and *inteleosts*, which ingest seawater; absorption also takes place across the walls of the gut. Of the four metals under consideration, cadmium may remain in aerated seawater in the greatest concentrations, followed by nickel, lead and chromium. The concentration of a metal lethal to a marine organism depends on the metal and the organism. The toxicity of each of the four metals is treated briefly, and a tabulation of reported toxicity phyla for each is included.

ACCESS # : 363, ARL

CITATION : Davies, W.P., G.I. Scott, C.D. Getter, M.O. Hayes and E.R. Gundlach. 1979. Methodology for environ. assess. of oil and hazardous substance spills. In: European Marine Biological Symposium on Protection of Life in the Sea. Vol. 33. pp. 246-256.

KEY-WORDS: Oil spills; Pollution effects.

SYNOPSIS : Ecological assessment of oil and hazardous material spills has been divided into three distinct phases: (1) first-order response studies-conducted at the time of the initial spill event, (2) second-order response studies-conducted 2 months to one year post-spill, which document any delayed mortality & attempt to identify potential sublethal impacts in sensitive species, and (3) third-order response studies-conducted one to three years post-spill, to document chronic impacts (both lethal and sublethal) to specific indicator species. First- and second-order response studies of the 'Peck Slip' oil spill in Puerto Rico illustrate the usefulness of this method. The need for contingency planning before a spill is discussed along with the use of the vulnerability to oiling. A study of the lower Cook Inlet section of the Alaskan coast illustrates the practical application of this method.

ACCESS # : 364, RAS-UAF

CITATION: Donahue, W.H., R.T. Wang, M. Welch, and J.A.C. Nicol. 1977. Effects of water-soluble components of petroleum oils and aromatic hydrocarbons on barnacle larvae. Environ. Pollut. 13:187-202.

KEY-WORDS: Toxicity; Barnacle larvae; Oil Pollution; Hydrocarbons.

SYNOPSIS : The effects of the water-soluble fractions (WSF) of petroleum oils and of solutions of aromatics on embryos and nauplii of barnacles Chthamalus fragilis and Balanus amphitrite(niveus) were investigated. The oils tested were S. Louisiana, Alaska, Kuwait, Venezuela crudes, Diesel fuel, Bunker C, No. 2 fuel and crankcase oils. Eighteen aromatic hydrocarbons occurring in petroleum oils were also tested. Observations were made on development and hatching of embryos, and the activity, phototaxis and survival of larvae. Acute experiments (1 h duration) were carried out in glass tubes illuminated above, and larvae remaining on the bottom were separated from those actively swimming. Concentrations at which half the larvae occurred in the bottom fraction were determined. Oils were toxic in the series used: Crankcase No.2 fuel oil Bunker C Diesel Venezuela Kuwait Alaska S. Louisiana (in terms of percentages of saturated solutions) are given. Embryonic development and larval activity were adversely affected by No.2 fuel oil at a concentration of 3 ppm and larval activity by naphthalene at the same level.

ACCESS # : 365, RAS-UAF

CITATION : Eaton, W.C. and B.A. Rattner. 1982. Effects of dispersant and crude oil ingestion on mallard ducklings (Anas platyrhynchos). Bull. Environ. Contain. Toxicol. 29: pp. 273-278.

KEY-WORDS: Growth; Food; Transport; Oil Pollution; Toxicity; Waterfowl.

SYNOPSIS : Experiments were carried out to study what effects a diet containing the dispersant, Corexit 9527, Prudhoe Bay crude oil, or both, has on the growth and blood chemistries of mallard ducklings (Anas platyrhynchos). The results are reported with tables, and it is concluded that the ducklings could ingest low levels of dispersant, or the dispersant combined with crude oil, for 9 weeks without showing any obvious signs of toxicity.

ACCESS # : 366, RAS-UAF

CITATION : Barrington, I.W., A.C. Davies, N.M. Frew and K.S. Rabin. 1982. Fuel oil compounds in Mytilus edulis. Retention and release after an oil spill. Mar. Biol. 66: 15-26.

KEY-WORDS: Hydrocarbons; Oil spill; Bivalves.

SYNOPSIS : Mytilus edulis contaminated by a brief 2-d exposure to a No.2 fuel oil spill in the Cape Cod Canal, Mass., USA were sampled six times during an end post-spill period to study the rate of release of fuel and compounds under field conditions. Detailed measurements of compounds by high resolution glass capillary gas chromatography and quantitative glass capillary gas chromatography-mass spectrometry-computer systems analyses provided a more comprehensive examination of release rates of different types of compounds. Biological half-lives were calculated for selected compounds for the first 21 d during which the release rates were exponential. Typical half-lives were n-alkanes, 0.2-0.8 d; pristane, 0.5 d; C-2 (dimethyl or ethyl) naphthalenes, 0.9 d; methylphenanthrenes, 1.7 d. Changes in relative ratios of C-2 phenanthrenes during the release period were observed. The evidence available to date strongly support the role of molecular weight and accompanying properties of water solubility as the main controlling factors in the rate of release of fuel oil compounds by M. edulis. However, the data for the rapid release of n-alkanes and C-2 phenanthrenes also indicate molecular configuration as additional key factors. The data from this study are compared and contrasted to data from short term experimental studies in the laboratory, data from longer term studies from chronic exposure conditions, and data from two other oil spills with longer term exposure.

ACCESS # : 367, ARL

CITATION : Fay, F.H. 1976. Morbidity and mortality of marine mammals. Principal Investigator Reports for the Quarter Ending September. Vol. 1. pp. 43-47. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Mortality; Oil pollution; Ecology; Distribution; Marine mammals.

SYNOPSIS : The coast of Kotzebue Sound from Bering Strait to Point Hope was surveyed for dead or moribund marine mammals. A total of 166 dead marine mammals was sighted, 92 of which were old weathered remains from previous years. The findings thus far suggest that two pathologic conditions, namely *dermatomycosis* and *streptococcosis*, occur frequently enough to merit further investigation of their rate of occurrence, present impact, and potential aggravation by the stresses of oil development activities and environmental pollution. Low level infections by agents of both conditions appear to be common to all or most of the pinnipeds inhabiting the Bering and Chukchi Seas, and acute infections occur frequently enough to have been conceivable that a variety of stresses potentially imposed by oil development could have a synergistic effect on both of these conditions.

ACCESS # : 368, EPA

CITATION : Feder, H.M., M. Cheek, P. Flanagan, S.C. Jewett, and M.H. Johnston. 1976. The sediment environment of Port Valdez, Alaska: The effect of oil on this ecosystem. Environmental Protection Agency. Ecological Research Series. Report EPA 600/3-76-086. pp. 322.

KEY-WORDS: Oil pollution; Benthos; Bivalves; Sediments; Pollution; Zooplankton; Crustacean; Mortality.

SYNOPSIS : The Port Valdez intertidal sediment system was studied for three years. Physical, geological, *geochemical*, hydrocarbon, and biological features were examined. Sediments were poorly sorted gravels to plastic clays, and had low amounts of organic matter. Bacterial numbers varied from site to site, and decreased in numbers with depth. *Meiofauna* consisted primarily of nematodes and *harpacticoid* copepods. Most *meiofaunal* species were restricted to the upper three centimeters throughout the year. *Meiofaunal* densities were typically highest in summer and lowest in winter. Reproductive activities of copepods tended to be seasonal with only one species reproducing throughout the year. Bacterial populations were unaffected by single applications. It is concluded that oil is removed rapidly by tidal action. Three species of copepods exposed to oil in the field significantly increased in density in experimentally oiled plots. Uptake and release of added oil by intertidal sediments and the clam (*Macoma balthica*) were examined in the field. Petroleum was not detectable two months after application to sediments.

ACCESS # : 369, RAS-UAF

CITATION : Federle, T.W., J.R. Vestal, G.R. Hater and M.C. Miller. 1979. Effects of Prudhoe Bay crude oil on primary production and zooplankton in Arctic tundra thaw ponds. Mar. Environ. Res. 2(1): pp.3-18.

KEY-WORDS: Pollution effects; Petroleum; Primary production; Zooplankton.

SYNOPSIS : The effects of Prudhoe Bay, Alaska, crude 011 on the indigenous phytoplankton and zooplankton of tundra thaw ponds were studied under controlled conditions in situ during the summer of 1976. These effects were compared with uncontrolled oil spills on Pond Omega (a year previously) and Pond E (six years previously). In the uncontrolled spills, the phytoplankton species composition of both ponds remained appreciably different compared with control Pond C, although phytoplankton biomass did not differ greatly. Primary production remained low in Pond Omega, but had recovered to control levels in Pond E. In controlled subpond experiments, oil caused a decrease of about 90-100% in primary production in five days, but recovered to 40-50% of the control level within fifteen days. During that time, phytoplankton biomass decreased initially, but recovered within fifteen days. Oil caused a shift in phytoplankton species composition from a predominance of cryptophytes to chrysophytes.

ACCESS # : 370, ARL

CITATION : Feely, R.A., J.D. Cline, G. Massoth, A.J. Paulson and M.F. Lamb. 1979. Composition, transport and deposition of suspended matter in Lower Cook Inlet Shelikof Strait, Alaska. Annual Reports of Principal Investigators for the Year Ending March 1979. Vol. V. pp. 195-263. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Circulation; Oil pollution; Water pollution; Heavy metals; Gulf of Alaska; Petroleum development; Oil.

SYNOPSIS : Of particular concern are the major accidents which cause massive oil spills, however, chronic release of oil through minor spills and localized transfer operations may be more important over the long term. Since crude oil is sparingly soluble in seawater, it tends to form emulsions when introduced into marine waters, especially under intense wave action. The emulsions have a high affinity for particles and tend to be adsorbed rapidly. Recent studies of oil spills in coastal waters containing high suspended loads have indicated rapid dispersal and removal of the oil by sorption onto particles along frontal zones. These zones are regions where turbid brackish water contracts seawater. The seasonal distributions, elemental composition, and fluxes of suspended particulate matter in lower Cook Inlet were studied and compared with current patterns and bottom sediment distributions, in general, the suspended matter distributions appear to follow the pattern of circulation in lower Cook Inlet and Shelikof Strait. The inflowing clear saline Gulf of Alaska water, which is enriched in biogenic particles of marine origin, flows northward along the eastern coast until it reaches the region near Cape Ninilchik where it mixes with the outflowing brackish water. Comparison of suspended matter and sediment characteristics as well as regional sedimentation rates indicates that net sedimentation of suspended matter in the central basin of lower Cook Inlet is minimal. However, net sedimentation is occurring in the embayments along the coast.

ACCESS # : 371, LGL-TORONTO

CITATION : Fey, M.G. 1982. Acute lethal toxicity of Prudhoe Bay crude oil and Corexit 9527 to arctic marine fish and invertebrates. Technology Development Report EPS (CANADA) 4-EC-82-3, pp. 62.

KEY-WORDS: Crustacea; Toxicity; Fishes; Hydrocarbons; Invertebrates; Oil; Copepod; Amphipods; Zooplankton.

SYNOPSIS : The toxicities of Prudhoe Bay crude oil, the dispersant Corexit 9527 and mixtures of the two to several arctic marine amphipods, one arctic marine copepod and one arctic marine fish, collected from Resolute Bay or Frobisher Bay, NWT, were investigated. Toxicities were assessed by semi-static 96 h bioassays in which the concentrations of hydrocarbons were measured by fluorescence spectroscopy. The sensitivities of all species to a given toxicant were of the same order, with LC_{50} values ranging from 50 to 200 ppm. However, mortality in oil-Corexit-water mixtures was much higher than in oil-water mixtures of the same nominal oil concentration, the actual oil content in the water column being much higher in the presence of the dispersant than when the two phases were mechanically mixed. Hence the higher mortality of the chemically dispersed oil-water mixtures is attributed to the higher concentration of oil encountered by the test organisms. When compared on the basis of measured oil concentrations, the dispersant appeared to diminish the toxicity of the mixtures, possibly by lowering the level of soluble aromatics in the aqueous phase.

Attachment :

ACCESS # : 372, RAS-UAF

CITATION : Foy, M.G., S.I.C. Hsiao and D.W. Kittle. 1978. Effects of crude oils and the oil dispersant Corexit on primary production of arctic marine phytoplankton and seaweed. Environ. Pollut. 15 (3): 209-221.

KEY-WORDS: Oil pollution; Algae; Phytoplankton; Seaweeds; Primary production.

SYNOPSIS : The authors have carried out an in-situ study which showed that mixtures of crude oil and Corexit were more toxic than crude oil or Corexit alone. In water samples with the same algal species composition, inhibition of production of phytoplankton generally increased with increasing oil concentration; primary production of two seaweeds was significantly inhibited by all types and concentrations of oil tested. This information may provide a greater awareness of potential indirect effects of oil pollution upon higher trophic levels and fish stocks.

ACCESS #: 373, RAS-UAF

CITATION : Gray, R.H., R.W. Hanf, D.D. Dauble and J.R. Skalski. 1982. Chronic effects of a coal liquid on a freshwater alga, Selenastrum capricornutum. Environ. Sci. & Tech. 16(4): 225-229.

KEY-WORDS: Algae; Population; Toxicity; Petroleum; Coal liquid.

SYNOPSIS : The authors have used a modification of the standard EPA Bottle toxicity test to evaluate the effects of water-soluble fractions of a solvent-refined coal liquid on the unicellular freshwater green alga, Selensastrum capricornutum. Relative toxicities of fractions of a Prudhoe Bay crude oil and No.6 fuel oil were also evaluated. Population response was measured during and after exposure to fractions prepared by sequentially extracting a blend of solvent refined coal middle heavy distillates with Columbia river water. The Prudhoe Bay crude and No.6 fuel oil were less toxic than coal liquid. Evidence was found of enhancement of algal populations at low concentrations of the water soluble fractions of the coal liquid.

ACCESS # : 374, IMS-UAF

CITATION: Green, F. 1976. EPA's view of projected oil drilling on the continental shelf. Sea Technol. 17(10): 10-13.

KEY-WORDS: Oil pollution; Coastal habitats.

SYNOPSIS : Offshore oil and gas development should allow for the husbanding of the living resources of the sea and the safeguarding of onshore values such as, recreational land, salt marshes, and human health. Since potential pollution from development of the OCS would directly threaten the coastal zone, guidelines are offered to oil drillers to prevent ecological disasters. More research is needed before the full effects of seabed oil extraction, toxicity of petroleum compounds in the food chain, and oil leaks among marine organisms can be determined. Present OCS policies are inadequate and must be reworked to include operating orders for new sites on the Atlantic Coast, Alaska, or Southern California. Coordination and planning among responsible federal and state agencies must improve. Sophisticated detection equipment is recommended to track major oil spills. A glaring omission in the overall spill prevention program is that regulations for transportation activities such as pipelines, railroads, and trucks have not yet been formulated. Safety measures could also be bolstered by additional funding for the Coast Guard patrol and clean-up activities.

ACCESS #: 375, RAS-UAF

CITATION : Griffiths, R.P., T.M. McNamara, B.A. Caldwell and R.Y. Morita. 1981. Field observations on the acute effect of crude oil on glucose and glutamate uptake in samples collected from arctic and subarctic waters. Appl. Environ. Microbiol. 41(6): 1400-1406.

KEY-WORDS: Oil pollution; Micro organisms; Sediments.

SYNOPSIS : The acute effects of crude oil on glucose uptake rates by marine microorganisms were studied in 215 water and 162 sediment samples collected from both arctic and subarctic marine waters. The mean percentage reduction of glucose uptake rates ranged from 37 to 58 in the water samples exposed to crude oil and from 14 to 36 in the sediment samples. Substrate uptake kinetic studies indicated that the observed reductions by microbial populations exposed to crude oil were caused by metabolic inhibition. The effect of crude oil was less in sediments than in the water samples, with the difference being significant at the P 0.0002 level. With the exception of one sediment study, all of the differences observed in the uptake rates between treated and nontreated samples were statistically significant. A high degree of variability was observed in the degree which glucose and glutamate uptake rates were altered in water samples exposed to crude oil. In some cases, uptake rates were greater in the samples exposed to crude oil. Data on samples collected in Cook Inlet probably chronically exposed to crude oil are also the areas where the effects of crude oil on glucose uptake are the lowest. Two studies indicated that after pelagic populations are exposed to crude oil for several days, the heterotrophic population adjusts to the presence of crude oil.

ACCESS # : 376, RAS-UAF

CITATION : Griffiths, R.P., T.M. McNamara, B.A. Caldwell and R.Y. Morita. 1981. Field study on the acute effects of the dispersant Corexit 9527 on glucose uptake by marine microorganisms. Mar. Environ. Res. 5(2): 83-91.

KEY-WORDS: Oil pollution; Microorganisms; Monosaccharides; Sediments; Glucose; Water column.

SYNOPSIS : The effects of the dispersant Corexit 9527 and Corexit with crude oil on the rate of glucose uptake and mineralization were studied in Arctic and subarctic marine waters and sediments. Essentially all of the 149 water and 95 sediment samples tested displayed decreased glucose uptake rates in the presence of either 15 or 50 ppm Corexit. Depressed uptake rates were observed at concentrations as low as 1 ppm. The mean concentration at which Corexit depressed glucose uptake by 50% was 12 ppm. The effect of Corexit was more pronounced on pelagic than on benthic microbial populations.

ACCESS # : 377, ARL

CITATION : Griffiths, R.P., and R. Y. Morita. 1978. Study of microbial activity and crude oil-microbial Interactions in the waters and sediments of Cook Inlet and the Beaufort Sea. Quarterly Reports of Principal Investigators for April-June. pp. 204-246. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil spills; Biological degradation; Micro organisms; Sediments; Water column; Nitrogen fixation.

SYNOPSIS : Studies of relative microbial activity and respiration (mineralization) ratios of natural microbial populations found in water and sediment found in water and sediment samples are continued. Areas which are shown to have particularly high activity should be those in which crude oil will be degraded at higher rates. These areas probably support the highest overall biological activity and as such may be the areas which will be most affected by the presence of crude oil. These data may also be used in the future to estimate the degree of perturbation caused by chronic crude oil input. The studies include crude oil effects on microbial functions as measured by uptake and respiration characteristics using several labeled compounds. They also include the study of nitrogen fixation and the effects of crude oil on this process.

ACCESS # : 378, RAS-UAF

CITATION : Hanna, B.M., J.A.Hellebust and T.C.Hutchinson. 1975. Field studies on the phytotoxicity of crude oil to subarctic aquatic vegetation. *Vereinigung Limnologie*. 19: 2165-2171.

KEY-WORDS: Primary production; Chlorophyll a; Oil pollution; Aquatic plants.

SYNOPSIS : To determine the effect of an oil pipeline spill on lakes and ponds in the arctic, oiled and control test cylinders were established in a small lake. Algal species showed reduced productivity after introduction of crude oil into the system. Moss also showed a reduction in productivity that was not statistically significant in terms of control productivity. Chlorophyll A and B concentrations for sedge and horsetails showed significant reductions from surface contamination with oil. Baseline data on several growth parameters of a vegetative subarctic aquatic community were established.

ACCESS # : 379, NMFS

CITATION : Hawkes, J.W. 1978. Morphology. In: NOAA Tech. Memorandum ERL OCSEAP-1 Marine Biological Effects of OCS Petroleum Development. pp. 87-92.

KEY-WORDS: Oil pollution; Salmonids; Fish; Physiology.

SYNOPSIS : The two major objectives are to identify the effects of petroleum on fish at the cellular level and to establish which tissues show the most obvious and repeatable structural alterations. A series of experimental designs have been followed to assess the effects of Prudhoe Bay crude oil or its water-soluble fraction on both pelagic and demersal species and on adult and young. The findings are reported by considering each major target organ and describing the alterations observed for each type of experiment and variation. The common theme is the type of cellular response of selected organs or tissues to toxic substances; namely, petroleum hydrocarbons. The observed liver changes parallel hepatic alterations known for other animals to be pre-neoplastic. The changes indicate that the ability of fish to survive additional routine environmental stress may be reduced, because of depletion of energy reserves or reduced liver functions.

ACCESS # : 380, EPA

CITATION : Hayes, M.O., G.I. Scott, W. P. Davies, C. D. Getter and E. R. Gundlach. 1980. Methodology for environmental assessment of oil and hazardous substance spills. Helgolander Meeresuntersuchungen. 33: 246-256.

KEY-WORDS: Geology; Oil spills; Ecology.

SYNOPSIS : An integrated zonal method for assessment of the ecological impact of oil spills is proposed which utilizes a team of 3-4 people (geologists and biologists) who undertake geological mapping and quantitative biological surveys within the affected area defining the nature of the ecosystem and the extent of penetration of the oil. The immediate survey is followed by regular monitoring at prescribed intervals to evaluate chronic effects. The scope of the method and its application in practice are described with reference to the Peck Siip oil spill off the northeast coast of Puerto Rico and the attendant pollution of mangrove forests along the coast. In addition the concept of a vulnerability index is developed as an aid to pre-spill contingency planning and some examples of its application are given, especially in the Cook Inlet portion of the southern Alaskan coastline.

ACCESS # : 381, NMFS

CITATION : Hodgins, H.O. 1978. Physiological and behavioral effects. In: NOAA Tech. Memorandum ERL OCSEAP-1. Marine Biological Effects of OCS Petroleum Development. pp. 72-86.

KEY-WORDS: Oil pollution; Physiology; Salmonids; Hydrocarbons; Fishes; Invertebrates; Behavior.

SYNOPSIS : Physiological and behavioral studies were designed as laboratory experiments--with the notable exception of field studies of salmon homing--to evaluate effects of sublethal petroleum exposure on species indigenous to the North Pacific Ocean tested under natural water quality and temperature conditions. The studies have provided clear implications that in certain instances heavy exposures of fish to the petroleum have little effect on physiology; whereas, in other instances, severe effects may result from light to moderate exposures to petroleum. In the category of severe exposure--little effect are the studies of oil in the diet on trout reproductions and the disease resistance research with salmon and trout. In both of these studies high doses of crude oil in diets induced little or no detectable physiological impairment. Conversely, exposure of spot shrimp and dorida nudibranchs to ppb levels of petroleum in seawater resulted in potentially disastrous effects on feeding behavior, reproductive behavior, or embryogenesis. Other studies such as effects of petroleum on salmon migration, may fall somewhere between the above two extremes.

ACCESS # : 382, RAS-UAF

CITATION : Hsiao, S.I. 1978. Effect of crude oil on the growth of arctic marine phytoplankton. Environ. Poll. 17(2): 93-107.

KEY-WORDS: Oil pollution; Phytoplankton; Growth.

SYNOPSIS : Growth responses of arctic marine phytoplankton to crude oils were determined at various temperatures and exposures in a defined medium at constant light energy. The growth of diatoms Chaetoceros spetentrionalis, Navicula bahusiensis, and Nitzschia delicatissima was inhibited by Atkinson Point, Norman Wells, Pembina, and Venezuela crude oils after 10 d exposure at a concentration of 10 ppm at 0 deg, 5 deg, and 10 deg, C. Growth of both diatoms and the green flagellate was markedly inhibited by oil concentrations >100 ppm, but diatoms were more severely impaired than the green flagellate. Greater inhibition generally occurred with longer exposure at temperatures between 5 deg and 10 deg, C than at 0 deg, C. Chlamydomonas was not killed by any of the crude oils at the concentrations, temperatures, and lengths of exposure tested. Lethal effects among diatoms varied with species, types of oil, temperatures, and lengths of exposure tested. Lethal effects among diatoms varied with species, species sensitivity of the phytoplankton to the oils was determined based on percentage survival, exponential growth rate, and generation time. Chlamydomonas was the most tolerant species and had a greater ability to resume growth, while diatoms were sensitive and had little or no ability to resume growth. Possible ecological consequences of such species sensitivity and differential growth are discussed.

ACCESS # : 383, RAS-UAF

CITATION : Hsiao, S.I.C., D.W.Kittle and M. G. Fey. 1978. Effects of crude oils and the oil dispersant Corexit on primary production of arctic marine phytoplankton and seaweed. Environ. Poll. 15(3): 209-221.

KEY-WORDS: Oil pollution; Primary production; Phytoplankton; Seaweeds.

SYNOPSIS : Effects were studied in-situ. The production rate varied with types and concentrations of crude oil, method of preparation of oil-seawater mixtures, environmental conditions, and species composition of each sample tested. In samples with the same species composition, inhibition of production generally increased with increasing oil concentration. The crude oil-Corexit mixtures were more toxic than crude oil or Corexit alone. in-situ primary production of the seaweeds Laminaria saccharin and Phyllophora truncata was significantly inhibited by all types and concentrations of oil tested.

ACCESS # : 384, ARL

CITATION : Jones, M.M. 1980. Environmental permitting for drilling in offshore areas: comments on the selection process for drilling fluids. Proceedings of Twelfth Annual Offshore Technology Conference. Houston, TX. May 5-8, 1980. Vol. 1. pp. 255-262.

KEY-WORDS: Toxicity; Water pollution; Petroleum development; Drilling mud.

SYNOPSIS : The decision-making process is examined with regard to the selection of drilling fluids in obtaining environmental permits for offshore drilling. increased exploration and production in offshore areas has been linked to heightened environmental concerns for the impact of drilling fluids on the existing biota. As an example of the decision-making process, a case study of toxicity testing on two mud additives (a defoamant and a lubricant) for use in the Alaskan Outer Continental Shelf (OCS) is presented. Acute toxicity test results with brine shrimp nauplii (Artemia salina) are presented and compared to recommended application rates. The ensuing decision-making process is briefly described and the final regulatory and corporate decisions to accept one and reject the other are discussed. Existing hierarchical toxicity testing protocols (developed primarily for pesticides) are reviewed for their sensitivity to many biological, chemical, logistical, and economic constraints specific to drilling fluids. A modified toxicity testing protocol is presented which considers the factors and can be expanded for additional consideration of site-specific factors.

ACCESS # : 385, NMFS

CITATION : Karrick, N.L., and E.H. Gruger, Jr. 1976. Pollution in the northeast Pacific Ocean. Mar. Fish. Rev. 38(11): 2-19.

KEY-WORDS: Pacific Ocean; Water pollution; Sublethal effects; industrial development.

SYNOPSIS : The relative freedom from pollution in the northwest Pacific Ocean has been an accident of geography and timing, especially a lower rate of industrialization and settlement than on other US coasts. Other important factors are the prevalence of on-shore winds and currents and the relatively narrow continental shelf with sharp dropoff. Emphasis in this report is directed toward use of coastal waters of northwestern North America for disposal of wastes from domestic, industrial, and agricultural activities, and toward criteria for evaluating effects on marine life. The following topics are addressed: (1) environmental factors, including physical environment, oxygen levels, temperature, and salinity; (2) contaminants, including physical transport, distribution, and toxicology (acute lethal and chronic sublethal effects); (3) short- and long-term effects of pollutants on marine life; and (4) contaminants discharged into the northeast Pacific, including domestic wastes (timber industry, logging, forest products, agriculture food processing, aluminum production, metals, chloralkali plants, petroleum refining and drilling, nuclear plants). A table shows sources and characteristics of contaminants to the area. The existence of pollution is evidenced by contaminated estuaries and levels of chlorinated hydrocarbons, such as DDT and PCBs, in the fat of marine mammals.

ACCESS # : 386, ARL

CITATION : Kooyman, G., R. Davies and M. Castellini. 1977. Conductance of immersed Pinniped and sea otter pelts before and after oiling with Prudhoe Bay Oil. In: D.A. Wolfe (ed), Fate and Effects of Petroleum Hydrocarbons in Marine systems and Organisms. Pergamon Press, NY. pp. 151-157.

KEY-WORDS: Fur seals; Sea lion; Walrus; Sea Otter; Thermoregulation; Oil pollution; Marine mammals.

SYNOPSIS: Thermal conductance (C) of the sea otter and several species of pinniped pelts was determined during immersion, after oiling, and after cleaning. A (C) of 7 Watts/(m² x °C) for the sea otter pup was the lowest measured in all controls. The highest was 58 W/(m² x °C) for the California sea lion. Most affected by oiling was the sea otter pup in which (C) doubled. Least affected was the sea lion in which no change in (C) occurred. Washing slightly reduced (C) of the adult otter and fur seal. The results indicate that even a light oiling would have marked detrimental effects on thermoregulatory abilities of otters and fur seals at sea. The thermal effects of oil on other adult pinnipeds while at sea would be slight.

ACCESS # : 387, ARL

CITATION : Kern, S., D.A. Moles, and S.D. Rice. 1977. Effects of low temperature on the survival of pink salmon and shrimp exposed to toluene, naphthalene, and the water-soluble fraction of Cook Inlet crude oil. Principal Investigator Reports for Year Ending March 1977. Vol. 12. pp. 66-84. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Shrimp; Temperature; Salmon; Cook inlet.

SYNOPSIS : Toxicity tests were conducted at different temperatures to determine the effects of temperature on survival of shrimp and fish exposed to oil & oil component solutions. Exposure concentrations declined with time, and at different rates for each temperature, simulating a point source spill in the environment. Shrimp (Pandalus goniurus and Eualus spp.) and pink salmon (Oncorhynchus gorbuscha) were tested (96 h bioassays) with toluene, naphthalene, and the water-soluble fraction (WSF) of Cook Inlet crude oil at 4 degrees, 8 degrees and 12 degrees C. Median tolerance limits (96-h TLM) were computed by probit statistics. Oil concentrations were measured by ultraviolet spectrophotometry. The effect of different temperatures on the toxicity of toluene, naphthalene, and the WSF of Cook Inlet crude oil solutions depended on species and toxicant. Survival of shrimp exposed to toluene and naphthalene was significantly less at higher temperatures. In contrast, survival of pink salmon exposed to toluene was significantly less at lower temperatures. Other tests did not yield significant temperature effects.

ACCESS # : 388, ARL

CITATION : Larrance, J.D. 1978. Composition and Source Identification of Organic Detritus in lower Cook Inlet. Annual Reports of Principal Investigators for the Year Ending March 1978. Vol. VII. pp. 334-349. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Fisheries; Plankton; Detritus; Cook inlet; Benthos; Petroleum development; Food web.

SYNOPSIS : Offshore petroleum development in lower Cook inlet will provide a potential source of contamination of the environment by accidental large spills and chronic low-level oil pollution. Such pollution would undoubtedly have a harmful effect on important commercial fisheries in lower Cook inlet. Benthic species harvested include snow, king, and Dungeness crab, shrimp, razor clams, and scallops. These are commercially harvested primarily within the rectangle bordered by Anchor Point, Kachemak Bay, the Barren Island, and Kamishak Bay. Some primary king crab recruitment grounds are within this area in the Bluff Point-Kachemak Bay region. The larval stages of these and other benthic species are planktonic and rely on phytoplankton as food. Adults in the benthic community ultimately depend on organic production from phytoplankton and other plants. Phytoplankton grazed by zooplankton enters the detrital food web via fecal pellet deposition. Other cells enter the benthos by sinking directly. As small sinking particles, the cells and pellets may act to transport oil from the surface to the bottom. Studies have indicated rapid removal and dispersal of surface oil by suspended particles. When oil enters seawater, emulsion of very tiny droplets can form. Some of the droplets become bound to particles by absorption and adsorption; they subsequently sink directly or are sedimented in fecal pellets after being ingested by zooplankton. Thus, ingestion and sorption act as precipitated mechanisms to transfer otherwise buoyant oil particles to the detrital food web.

ACCESS # : 389, ARL

CITATION : Larrance, J.D., D.A. Tennant, A.J. Chester and P.A. Ruffo. 1977. Phytoplankton and primary productivity in the northeast Gulf of Alaska and lower Cook Inlet. Annual Reports of Principal investigators for the Year Ending March 1977. Vol. 10. pp. 1-136. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Primary production; Phytoplankton; Oil pollution; Chlorophyll a; Nutrients; Hydrography.

SYNOPSIS : The phytoplankton and primary productivity studies in the northeastern Gulf of Alaska and lower Cook Inlet were designed to provide a baseline of phytoplankton standing stocks and rates of primary production in those areas. Measurements were made within the upper 50m of water of chlorophyll a, primary production, inorganic nutrient concentrations, temperature, salinity, and incident and underwater ambient irradiance. The several dominant phytoplankton species and their population densities were determined. The data have been examined for relationships to productivity and standing stocks in order to gain insights into the major forces which drive primary production. Although phytoplankton are likely to repopulate an area shortly following an oil spill, the species composition may be very different after prolonged contamination. The new dominant species may be inadequate to nourish grazers, and thus significant changes may occur in the food web. In addition to large spills, continuous or intermittent low-level contamination is almost certain to exist in the area around and downstream of an oil field. The resultant chronic effects on phytoplankton production are virtually unknown.

ACCESS # : 390, ARL

CITATION : Lee, R.F. 1975. Fate of petroleum hydrocarbons in marine zooplankton. Proceedings 1975 Conference on Prevention and Control of Oil Pollution. pp. 549-553.

KEY-WORDS: Oil pollution; Zooplankton; Copepods; Metabolism; Physiology; Toxicity; Amphipods.

SYNOPSIS : The uptake, metabolism, storage and discharge of petroleum hydrocarbons by marine zooplankton were discussed in light of the marine food web. Both paraffinic and polycyclic aromatic hydrocarbons were added to seawater containing various species of zooplankton-copepods, euphausiids, amphipods, crab zoea, ctenophores and jellyfish- collected off California, British Columbia, and in the arctic. Hydrocarbons found included ³H-Benzpyrene, ¹⁴C-Benzpyrene, ³H-Methylcholanthrene, and ¹⁴C-Naphthalene.

ACCESS # : 391, ARL

CITATION : Lees, D.D., and W.B. Dridkell. 1981. Investigations on shallow subtidal habitats and assemblages in lower Cook Inlet. Final Reports of Principal investigators. pp. 417-610. OCSEAP/NOAA, Boulder, co

KEY-WORDS: Benthos; Oil pollution; Cook Inlet; Seaweeds; invertebrates.

SYNOPSIS : The main objectives were to expand the available information base on shallow subtidal habitats in Kachemak and Kamishak Bays, to describe the large horse mussel (*Modiolus*) assemblage in more detail, and to examine the trophic structure of shallow subtidal assemblages. Major emphasis was given to rocky substrates. Three important types of assemblages were observed on shallow subtidal rocky habitats. The southern Kachemak Bay assemblage, strongly resembling shallow subtidal rocky assemblages in the northeastern Pacific, was strongly dominated by kelps and is probably least vulnerable to impingement of oil contamination and least sensitive to the effects of an acute oil spill. The northern Kachemak Bay assemblage included an important kelp component but was strongly dominated by suspension feeders. Standing stocks of suspension feeders were very high. This assemblage is probably moderately vulnerable to impingement, but highly sensitive to the effects of an acute oil spill. The Western Cook Inlet assemblage, strongly resembling epifaunal assemblages in the Bering and Beaufort Seas, was strongly dominated by suspension feeders. Except in the intertidal and very shallow subtidal zones, kelps were absent. The area is probably highly vulnerable to impingement of oil contamination and highly sensitive to the effects of acute oil spills.

ACCESS # : 392, ARL

CITATION : Malins, D.C. 1977. Biotransformation of petroleum hydrocarbons in marine organisms indigenous to the arctic and subarctic. in: D.A. Wolfe (ed.), Fate and Effects of Petroleum Hydrocarbons in Marine Organisms and Ecosystems. Pergamon Press. New York, NY. pp. 47-59.

KEY-WORDS: Metabolism; Toxicity; invertebrates; Plankton; Fish; Oil pollution.

SYNOPSIS : The metabolism of the aromatic hydrocarbon fraction of petroleum by marine organisms was evaluated. It was pointed out that studies on the effects of petroleum on marine organisms have centered on the parent hydrocarbons rather than the potentially toxic metabolites. The biochemical pathways used by various plankton, invertebrates and fish to metabolize aromatic hydrocarbons were discussed. Particular emphasis was directed toward metabolite alterations of enzyme systems, tissue locations of various metabolites, and possible mutagenic activity.

ACCESS # : 393, ARL

CITATION : Malins, D.C., E.H. Gruger, Jr., H.O. Hodgins & N. Karrick. 1978. Sublethal effects of petroleum hydrocarbons and trace metals, including biotransformation as reflected by morphological, chemical, physiological, pathological & behavioral indices. Annual Reports of Principal Investigators for the Year Ending March 1978. Vol. VII. pp. 12-146. OCSEAP/NOAA, Boulder, CO
KEY-WORDS: Metabolism; Oil pollution; Hydrocarbons; Trace metals; Vertebrates; Invertebrates; Sublethal effects.

SYNOPSIS : Primary objectives of this research were to define and evaluate: (1) the alterations in structure of eggs, larvae, livers, and tissues of fish after petroleum exposure; (2) the importance of skin and epidermal mucus in metabolism and disposition of petroleum hydrocarbons in salmonids and flatfish; (3) the uptake, metabolism, and elimination of petroleum aromatic hydrocarbons by salmonids and flatfish; (4) the enzymes (aryl hydrocarbon monooxygenases) that metabolize and detoxify or activate aromatic hydrocarbons in a variety of aquatic species; (5) the physiological and embryological effects of aromatic hydrocarbons on early life forms of invertebrates; (6) the pathological effects of exposure of flatfish to crude petroleum-contaminated sediment; (7) the effects of exposure to petroleum on diseased vertebrate and invertebrate species exposed to petroleum hydrocarbons. The conclusions of this program are summarized according to disciplinary areas of study.

ACCESS # : 394, ARL

CITATION : Malins, D.C., E.H. Gruger, Jr., H.O. Hodgins and D.D. Weber. 1977. Sublethal effects of petroleum hydrocarbons and trace metals, including biotransformation, as reflected by morphological, chemical, physiological, pathological, and behavioral indices. Annual Reports of Principal Investigators for the Year Ending March 1977. Vol. 12. pp. 125-298. OCSEAP/NOAA, Boulder, CO
KEY-WORDS: Oil pollution; Petroleum development; Shrimp; Salmon; Fishes; Physiology; Behavior.

SYNOPSIS : Several findings have implications with respect to petroleum effects on aquatic species and consequently to OCS oil and gas development. Most of the studies were designed laboratory experiments and the degree to which laboratory results can be directly applied to natural events remains a considerable problem. The observed susceptibility of postlarval and adult shrimp to very low levels of naphthalene in seawater strongly suggest that petroleum introduced into the environment of these and related animals would have substantial deleterious effects. Similarly, the observed structural changes in salmonid fish after hydrocarbon exposure, and the uptake and retention of toxic trace metals by salmon and flatfish imply that the presence of petroleum and trace metals at some concentrations in diet, water, or sediment would be harmful to these species. Controlled field studies on salmon homing indicated that low concentrations of hydrocarbons do not affect salmon homing behavior or ability and thus imply that petroleum hydrocarbons in the path of migrating salmon would not completely disrupt their migration. The fact that greater accumulations of hydrocarbons were found in exposed fish at 4 degrees C, as compared to 10 degrees C, suggests that cold water environments may substantially increase hydrocarbon burden under arctic conditions in comparison to temperate regions.

ACCESS # : 395, NMFS

CITATION : Matins, D.C., E.H. Gruger, H.O. Hodgins, N.L. Karrick and D.D. Weber. 1978. Sublethal effects of petroleum hydrocarbons and trace metals including biotransformations, as reflected by morphological, physiological, pathological, and behavioral indices. In: Marine biological effects of OCS petroleum development. D.A. Wolfe (ed), NOAA/ERL. Boulder, Colo. pp. 25-40.
KEY-WORDS: Trace metals; Oil pollution; Behavior; Physiology; Fishes; Invertebrates.

SYNOPSIS : A significant body of evidence has been accumulated to indicate that aromatic hydrocarbons are rapidly and progressively converted to metabolites in the pelagic and demersal fish and in invertebrate larval forms. The literature on animal systems in general affirms the concept that extremely low levels of arene oxides are damaging to biological systems in many ways, which includes their strong mutagenic and carcinogenic potential. The tendency of starry flounder to accumulate high proportions of metabolites in skin is of interest with respect to their known susceptibility to lesion formation in this tissue. Evidence presented for the role of mucus in the excretion of naphthalene and metabolizes in fish suggests that such exudates must be considered along with other routes of elimination which lead to the recycling of petroleum and metabolic products in the marine environment. The findings to date imply that the pelagic species may be less susceptible to accumulating aromatic hydrocarbons from the environment than the demersal species, although a wider variety of different organisms must be studied in each class to verify this hypothesis.

ACCESS # : 396, ARL

CITATION : Matins, D.C., H.O. Hodgins, B.B. McCain, D.D. Weber, U. Varanasi and D.W. Brown. 1980. Sublethal effects of petroleum hydrocarbons and trace metals, including biotransformation, as reflected by morphological, chemical, physiological, pathological, and behavioral indices. Annual Reports of Principal investigators. Vol. 3. pp. 13-79. OCSEAP/NOAA, Boulder, Colo.
KEY-WORDS: Oil pollution; Physiology; Salmonids; Fishes; Trace metals; Food-web; Chemistry.

SYNOPSIS: Results of this program have implications with respect to petroleum effects on aquatic species and consequently to OCS O11 and gas development. The studies were designed as laboratory experiments on oil exposures of marine organisms in flowing-seawater tanks. Pink and chum salmon fry spend several months in coastal estuaries before going to sea, and at this life stage they are extremely vulnerable to predation by other salmonid fishes. Predator-prey studies are in progress to determine if fry are affected by petroleum differentially from adult predators so that they suffer substantially increased predation. Pleuronectid fish were able to take up BP from oiled sediment and diet and convert it extensively into mutagenic and carcinogenic metabolizes. The results show that metabolites of BP were retained in tissues of flatfish over a much longer period than naphthalene and its metabolizes. The presence of PAH and their metabolites in edible tissues can also have a serious impact on consumer acceptability of fish. Fresh and weathered O11 exposure would result in high mortality of flatfish embryos and larvae. Also, flatfish eggs exposed to fresh and weathered PBCO were frequently ruptured. Exposure to chum salmon and surf smelt eggs to the SWSF of weathered crude oil also resulted in reduced survival.

ACCESS # : 397, ARL

CITATION : Malins D.C., H.O. Hodgins, N.L. Karrick, D.D. Weber. 1979. Sublethal effects of petroleum hydrocarbons and trace metals, including biotransformation, as reflected by morphological, chemical, physiological, pathological, and behavioral indices. Annual Reports of Principal Investigators for the Year Ending March 1979. Vol. 6. pp. 60-71. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Fishes; Behavior; Sediments; Physiology.

SYNOPSIS : The overall objective of this program was to assess potential effects of petroleum and petroleum-related operations on marine organisms indigenous to Alaskan waters. Several principal objectives addressed by this research were: (1) to evaluate the effect of petroleum on sensory systems and behavior of marine species (2) to investigate the metabolism and disposition of petroleum hydrocarbons in demersal fish (3) to develop and refine ultrastructural criteria for assessing cellular damage in marine organisms resulting from exposure to petroleum (4) to detect and characterize pathological changes resulting from the exposure of flatfish to sediments contaminated with crude oil (5) to determine if petroleum-exposed eggs and larvae of salmon and flatfish develop abnormally, and to evaluate the effect of any detected abnormalities on survival. The conclusions of this program are summarized according to disciplinary areas of study.

ACCESS # : 398, ARL

CITATION : Malins, D.C., E.H. Gruger, Jr., H.O. Hodgins, N.L. Karrick and D.D. Weber. 1978. Sublethal effects of petroleum hydrocarbons and trace metals, including biotransformation, as reflected by morphological, chemical, physiological, pathological, and behavioral indices. Reports of Principal Investigators for April-June 1978. pp. 82-99. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Trace metals; Oil pollution.

SYNOPSIS : The responses of marine organisms to environmental contaminants are reflected in numerous changes that are detectable at population and organismic levels, as well as at cellular and molecular levels. The general scope of this study is to evaluate effects caused by behavioral, physiological, pathological, morphological, and chemical changes in subarctic and arctic marine animals exposed to petroleum hydrocarbons and trace metals.

ACCESS # : 399, ARL

CITATION : Malins, D.C., H.O. Hodgins and D.D. Weber. 1976. Sublethal effects as reflected by morphological, chemical, physiological and behavioral indices. Principal Investigators' Reports for the Year Ending March 1976. Vol. 8. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Ecology; Salmon; Physiology; Fishes.

SYNOPSIS : Preliminary experiments in cell biology indicated that the liver of trout (*Salmo gairdneri*) is a primary site of alteration in biochemical activity when the fish ingest crude oil. The liver showed two major changes: a depletion of energy storage products, glycogen and lipid, and an increase in the endoplasmic reticulum, a component of cells that is instrumental in protein synthesis. When Coho salmon, (*Oncorhynchus kisutch*) and English sole (*Parophrys vetulus*) were immersed in a sublethal concentration of water-soluble fraction of crude oil there appeared to be a depletion of mucus from the producing cells at the skin surface. These cellular changes are considered to be symptomatic of deleterious effects of petroleum oil on all three species of fish. In contrast, in related experiments, the feeding of intentionally high levels (one part/1000 oil in food) of crude oil to sexually maturing trout for six months did not result in mortality or grossly detectable damage prior to spawning; nor did it appear to impair the viability of their eggs and sperm.

ACCESS # : 400, IMS-UAF

CITATION : Mann, K.H. 1978. A biologist looks at oil in the sea. Shore and Beach 46 (4): 27-29.

KEY-WORDS: Ecosystems; Stress; Oil pollution; Decomposition; Ecology.

SYNOPSIS : Long and short-term effects of oil pollution in the sea are studied. Precise predictions of the harmful effects of such pollution from a biological standpoint are virtually impossible because of the variability and adaptability of marine animal and plant life. Dynamic modeling of this natural ecosystem has never been successful because of these variances. Oil spills that occur in the open sea have a less harmful effect than those occurring in nearshore waters. Organisms that die and decompose in the open ocean tend to sink to deeper waters where they release N and P compounds needed for plant growth; ocean currents subsequently transport these nutrients to marine communities that thrive in nearshore waters. When oil pollutes the coastal waters damage is felt in differing degrees depending upon the type of oil spilled and the type of life existing there. Following cleanup, it usually takes 10 yr for plant and animal life to repopulate in temperate waters. Because of cold temperatures, a short growing season, and long periods under ice, there is less species diversity in the arctic. Since this marine life naturally abides under stressed conditions, the further stress of an oil spill could be catastrophic for these ecosystems. The effects of potential oil spills in arctic waters are examined. The subject of sublethal effects of oil on individual organisms is not fully understood; more time and money should be allocated to the study of both basic and applied aspects of ecology.

ACCESS # : 401, RAS-UAF

CITATION : Mann, K.H., and R.B. Clark. 1978. Long-term effects of oil spills on marine intertidal communities. J. Fish. Res. Bd, of Can. 35(5): 791-795.

KEY-WORDS: Oilpollution; Sediments; Toxicity; Ecosystems; Hydrocarbon; Intertidal habitats.

SYNOPSIS : The title of this symposium is "Recovery Potential of Oiled Marine Northern Environments". It is clear from the case histories of oil spills reported here that the potential for recovery is indeed present. In most cases, within 10 years of a single incident the community structure has returned to something approaching its normal state. The rate of recovery depends on many factors. One is the toxicity and quantity of oil involved; light fuel oil is much more toxic than crude oil or bunker oil and causes much greater environmental damage. Another is the nature of the shoreline on which the oil is stranded; on a high-energy, rocky shore, the oil is dispersed and removed by wave action much more quickly than on a sheltered, sedimented site, where the oil may become incorporated in sediments, persist for many years, and cause chronic perturbations to the ecosystem. A third is the biology of the organisms that have been affected. Organisms with little or no mobility and slow rates of reproduction will take much longer to recolonize a damaged area than species that produce large numbers of young that are widely dispersed. Since the former is a characteristic reproductive pattern for many organisms living in high latitudes, recovery of damaged arctic environments may be much slower than that of the temperate and subboreal environments that were the subjects of these investigations.

ACCESS # : 402, ARL

CITATION : Mecklenburg, T.A., and S.D. Rice. 1977. Effects of Cook Inlet crude oil, benzene, and naphthalene on heart rates of the Alaskan king crab (*Paralithodes camtschatica*). Principal Investigators? Reports for the Year Ending 1977. Vol. 12. pp. 85-125. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Crabs; Oilpollution; Sublethal effects; Naphthalene; Physiology; *Paralithodes camtschatica*; Crustacea.

SYNOPSIS : Continuous monitoring of heart rates during exposure to toxicants was found to be a sensitive indicator of sublethal responses in the King crab, *Paralithodes camtschatica*. In exposures to water-soluble fractions of Cook Inlet crude oil, benzene, and naphthalene, the heart rate response was consistently one of depression, followed by return to normal as the crude oil or aromatic concentrations in the seawater declined. In one of the experiments with crude oil, respiration was also monitored; it closely paralleled the changes in heart rate. In another, using periodically replenished crude oil water-soluble fractions, the heart rate remained depressed until the oil concentration was allowed to drop. Benzene produced more severe and longer-lasting heart rate depressions than did naphthalene or crude oil; the response of benzene also occurred much sooner after initial exposure. The long-lasting sublethal effect of benzene was evident even though the benzene degraded more rapidly in the water than either crude oil or naphthalene. All of the experiments substantiated a strong relationship between oil or aromatic fraction degradation and heart rate recovery.

ACCESS # : 403, ARL

CITATION : Mecklenburg, T.A., S.D. Rice and J.F. Karinen. 1977. In: D.A. Wolfe (ed.), Fate and Effects of Petroleum Hydrocarbons in Marine Organisms and Ecosystems. Pergamon Press, New York, NY. pp. 221-228.

KEY-WORDS: Oil pollution; Mortality; Toxicity; Shrimp; Crabs; Larvae; Crustacea.

SYNOPSIS : Larvae of the Coonstripe shrimp and King crab were exposed to solutions of the water-soluble fraction (WSF) of Cook Inlet crude oil in a series of bioassays on intermolt stages I and II and the molt period from stage I to stage II. Molting larvae were more sensitive than intermolt larvae to the WSF, and molting King crab larvae. When molting larvae were exposed to high concentrations of the WSF for as little as 6 hr, molting success was reduced by 10-30% and some deaths occurred. When larvae were exposed to these high concentrations for 24 hr or longer, molting declined 90-110% and the larvae usually died. The lowest concentrations tested did not inhibit molting at any length of exposure, but many larvae died after molting. Median lethal concentrations (LC_{50} 's) based on 144 hr of observation for molting Coonstripe shrimp and 120 hr for molting King crab were much lower than the 96-hr LC_{50} 's showing that the standard 96-hr LC_{50} is not always sufficient for determining acute oil toxicity.

ACCESS # : 404, ARL

CITATION : Mickelson, P.G., W. Lehnhausen, S.E. Quinlan. 1978. Community structure of seabirds of Wooded Island, Alaska. Principal Investigators! Reports for the Year Ending March 1978. Vol. III. pp., 680-772. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: seabirds; Oil pollution; Gulf of Alaska; Wooded Islands; Community structure.

SYNOPSIS : Information was obtained about the breeding distribution, abundance, phenology, and productivity of seabirds using Wooded Island in the Gulf of Alaska. Major seabird species on Wooded Islands, and those discussed in this report are: Tufted Puffins, Fork-tailed Storm Petrels, Glaucous-winged Gulls, Cormorants (Double-crested, Pelagic, and Red-faced), Pigeon Guillemots, Common Murres, Parakeet Auklets, and Horned Puffins. Wooded Islands may become an attraction to tourists and residents of Alaska because of their accessible location and the variety of breeding seabirds and marine mammals they harbor. Wooded islands and the surrounding waters are threatened with oil pollution in the near future. Outer Continental Shelf oil and gas exploration has already begun in the northern Gulf of Alaska. Oil tankers are carrying crude oil south by Wooded Islands from the Valdez terminal of the Trans-Alaska oil pipeline. The effects of oil spills on Wooded Islands seabirds and other birds using the area depends largely upon the amount of oil spilled, the time of year of the spill, the stage of tides, wind velocity when oil reaches Wooded Islands area, and the success of clean-up measures. In summary, oil spills can produce a variety of direct and indirect effects which reduce the survival of birds. All possible caution should be used to minimize the probability of a large oil spill. Chronic low level oil pollution especially should be minimized. It is potentially more dangerous to the ecosystem than catastrophic spills since food organisms may concentrate hydrocarbons and remain contaminated for several years

ACCESS # : 405, NW&AFC

CITATION : Moles, A. 1980. Sensitivity of parasitized coho salmon fry to crude oil, toluene, and naphthalene. Trans. Amer. Fish. Soc. 109(3):293-297.

KEY-WORDS: Fish; Larvae; Oil; Salmon; Toxicity; Bivalves; Naphthalene; Toluene; Parasitism.

SYNOPSIS : Coho salmon fry (Oncorhynchus kisutch) Infested with Anodonta oregonensis derived glochidia and exposed to naphthalene had a 96-hour LC_{50} value of 0.77 mg per litre, compared to the control fish LC_{50} value of 3.2 mg per litre; the respective LC_{50} values after exposure to toluene were 3.08 ul per litre and 9.36 ul per litre. The effect of the extent of parasitism and toxicant on the fry was nearly additive. The tolerance limit for the three toxicants was 30-40 per cent below that for fish without parasitic infections. Glochidia, although not toxic to fish per se, decrease the energy resources available to the fish, increasing their sensitivity to all the toxicants.

ACCESS # : 406, NW&AFC

CITATION : Moles, A, A. Bates, D. Rice, and S. Kern. 1981. Reduced growth of coho salmon fry exposed to two petroleum components, toluene and naphthalene, in fresh water. Trans. Amer. Fish. Soc. 110: 430-436.

KEY-WORDS: Salmonids; Naphthalene; Toluene; sublethal effects; Physiology.

SYNOPSIS : Coho salmon, Oncorhynchus kisutch, fry were exposed for 40 days to stable, sublethal concentrations of toluene (0.4, 0.8, 1.6, 3.2, 5.8 ul/liter) and naphthalene (0.2, 0.4, 0.7, 1.4 mg/liter) in fresh water. All fry were fed equal rations of Oregon Moist Pellet Formula II. Dry weights, wet weights, and lengths of fry exposed to the two highest concentrations of each toxicants for 40 days were significantly less than controls ($P < 0.01$). Growth per day, determined from weights and lengths, decreased linearly with increased concentrations. Fry exposed to naphthalene had a slower growth rate than fry exposed to equivalent concentrations (percentage of the 96-hour median lethal concentration or LC_{50}) of toluene. Concentrations 18% of the LC_{50} of naphthalene and 26% of the LC_{50} of toluene had no effect on dry weight, wet weight, or length of exposed fry.

ACCESS # : 407, NW&AFC

CITATION : Moles, A., S.D. Rice, and S. Kern. 1979. Sensitivity of Alaskan freshwater and anadromous fishes to Prudhoe Bay crude oil and benzene. Trans. Amer. Fish. Soc. 108(4): 408-414.

KEY-WORDS: Salmon; Toxicity; Petroleum; Hydrocarbons; Prudhoe Bay; Sculpins. Fishes.

SYNOPSIS : Freshwater juveniles of the 6 salmonid species tested had similar sensitivities in the 96-hour toxicity tests. Median tolerance limits (TLM's) of these salmonids for crude oil ranged from 2.7 to 4.4 mg/L; TLM's of benzene ranged from 11.7 to 14.7 µL/L. Threespine sticklebacks Gasterosteus aculeatus and, to a lesser extent, slimy sculpins Cottus cognatus were more tolerant than salmonids and had larger TLM's: threespine sticklebacks had a crude-oil TLM of 10.4 mg/L and a benzene TLM of 24.8 µL/L; slimy sculpins had a crude-oil TLM of 6.44 mg/L and a benzene TLM of 15.4 µL/L. Eggs of pink salmon Oncorhynchus gorbuscha and coho salmon O. kisutch were quite tolerant to crude oil (TLM > 12 mg/L) and benzene (TLM=339-542 µL/L). Emergent fry were the most sensitive freshwater stage (crude-oil TLM=8.0 mg/L; benzene TLM=12.3-17.1 µL/L). Out-migrant salmonids, tested in seawater, were twice as sensitive as out migrant salmonids tested in freshwater, probably due to the additional stress of entering seawater and the physiological changes associated with this transition. Freshwater TLM's were 2.3-8.0 mg/L for crude oil and 10.8-17.1 µL/L for benzene. Corresponding seawater sensitivities were 1.1-3.6 mg/L for crude oil and 5.5-8.5 µL/L for benzene.

ACCESS # : 408, IMS-UAF

CITATION : Morita, R.Y., B.A. Caldwell, R.P. Griffiths, and T.M. McNamara. 1981. A field study on the acute effects of the dispersant Corexit 9527 on glucose uptake by marine micro-organisms. Mar. Environ. Res. 5(2): 83-91.

KEY-WORDS: Oil pollution; Sediments; Glucose; Microbiology.

SYNOPSIS : Samples of water and sediment were collected from four areas along the Alaskan coast and used to study the effects of the oil dispersant Corexit 9527, and Corexit with crude oil, on microbial function in the marine environment. The results, reported with maps and tables, show that Corexit depresses glucose uptake rates, and it was found to affect the pelagic microbial populations more than the benthic microbial populations.

ACCESS # : 409, ARL

CITATION : Morita, R.Y., and R.F. Griffiths. 1976. Baseline study of microbial activity in the Beaufort Sea and Gulf of Alaska and analysis of crude oil degradation by psychophilic bacteria. Principal Investigators' Reports for the year ending March 1976. Vol 10. pp. 147-191. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Micro-organisms; Water pollution; Sediments; Bacteria; Biological degradation.

SYNOPSIS : The levels of potential glutamic acid uptake observed in water samples taken from the Beaufort Sea were as high as those observed in other relatively productive marine waters. In both Barrow and Prudhoe Bay there were locations which consistently showed higher levels of potential microbial activity. When the effects of incubation temperature on the maximum potential velocity of glutamic acid uptake were studied, it was found that there was a marked increase with increasing incubation temperature. Studies on the effects of melted ice water on heterotrophic potential data suggest that when melting ice water is released into the surrounding seawater, there is little effect on the observed microbial activity or the percent respiration. The acute effects of crude oil on the uptake and respiration of glutamic acid were studied by adding an aqueous crude oil extract to the reaction bottles used to determine heterotrophic potential. No consistent alteration in function was observed when the extract was added. Changes in the heterotrophic potential with time were studied in a natural microbial population exposed to crude oil using both labeled glutamic acid and acetate. In the initial stages of incubation, the levels of activity were lower in the crude oil enrichment but as incubation progressed, the levels of activity increased. Sulfate reducing bacteria appear to be very common in the inshore sediments of the Beaufort Sea. Psychophilic crude oil degrading bacteria are probably quite rare in the waters of the Beaufort Sea.

ACCESS # : 410, IMS-UAF

CITATION : Morrow, J.E. 1973. Oil-induced mortalities in juvenile coho and sockeye salmon. J. Mar. Res. 31: 135-143.

KEY-WORDS: Fish; Oil pollution; Transport; Toxicity; Salmon; Temperature.

SYNOPSIS : Laboratory experiments were carried out, under conditions simulating those of the Alaskan fisheries areas, to investigate the possible effects of oil pollution on juvenile coho and sockeye salmon, with reference to the proposed Trans-Alaska oil pipeline. The results are tabulated and show that there were significant increases in mortality rates of fish, for all the tested oil concentrations, ranging from 500 to 3500 ppm and for all tested water temperatures; 3, 8, and 13 C. Mortality rates were found to be directly related to oil concentration, and inversely to temperature, and crude oil was found to lose its toxicity to salmon after exposure to air, possibly through loss of volatile toxic components.

ACCESS # : 411, RAS-UAF

CITATION : Mozley, S.C., and M.G. Butler. 1978. Effects of crude oil on aquatic insects of tundra ponds. *Arctic* 31(3): 239-241.

KEY-WORDS: Insects; Aquatic animals; Ponds; Oil pollution.

SYNOPSIS : Aquatic Insects comprise most of the biomass and production of tundra thaw ponds. Field experiments on two ponds with application rates of about 10 l/m.² SUP-2 (Pond E 1970) and 0.24 l/m.² SUP-2 (Pond . 1975) resulted in the selective elimination of *Asynarchus* (Trich., Limnephilidae) and *Nemoura* (Pisces, Nemouridae). Chironomidae in Pond . displayed much lower rates of adult emergence in 1976 and 1977 than in 1975, immediately before and after oil treatment, with several species in the tribe Tanytarsini most reduced. Pond E did not show low emergence rates, but the proportion of Orthocladiinae was much higher than in reference ponds. *Trichotanypus* was severely reduced in Pond . but unusually abundant in Pond E in 1976 and 1977. Effects of oil seem to be different for different species, and occur at some point during the late larval stages of insects or at metamorphosis, but toxicity experiments did not confirm this. Oil may also interfere with reproduction in insect species which remain mainly on or near the pond surface as adults. There is no indication of recovery of *Nemoura*, *Asynarchus*, or Tanytarsini in Pond E seven years after the spill, but biomass and abundance of the other aquatic insects remain high. It is recommended that clean-up measures avoid introducing solvents or dispersants, which might be toxic to insects in the ponds.

ACCESS # : 412, IMS-UAF

CITATION : Mozley, S.C. 1978. Effects of experimental oil spills on Chironomidae in Alaskan tundra ponds. *Verhandlungen Internationale Vereinigung für Theoretische und Angewandte Limnologie*. 20(3): 1941-1945.

KEY-WORDS: Oil pollution; Benthos; Insects; Toxicity; Mortality; Reproduction.

SYNOPSIS : A study was made of the effects of Prudhoe Bay crude oil spilled on four tundra ponds near Point Barrow, Alaska. Initially oil killed macro-invertebrates only in peripheral areas when they could contact it on plants and at the surface. In one treated pond one species *Trichotanypus* was virtually eliminated but in another pond an unusually large population became re-established. The residual slick interfered with mating oviposition of chironomids among the plants. Major oil spills could eliminate a major food resource for breeding birds.

ACCESS # : 413, ARL

CITATION : Muench, R.D., J.D. Schumacher, and R. Silcox. 1979. Northwest Gulf of Alaska shelf circulation. Principal Investigators' Reports for the year Ending March 1979. Vol. VII. pp. 232-248. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Currents; Oil pollution; Sediments; Transport; Oceanography; Petroleum development.

SYNOPSIS : The objective of this work is to relate oceanic advective and diffusive processes to potential pollution problems due to OCS petroleum development. This is accomplished through field activities including moored current measurements and water mass analysis using temperature and salinity observations. The regions being considered include the northwest Gulf of Alaska continental shelf west from about the longitude of Seward, Alaska to Unimak Pass and extend offshore to the outer boundary of the Alaskan Stream some 100 km off Kodiak Island. This study provides estimates of the fields of water motion which exert primary control over trajectories of spilled oil and over diffusion processes along the trajectories. Oil introduced into the environment via long-term or chronic leakage is more likely to be dispersed throughout the water column and, possibly scavenged by suspended particulate matter. The problem then becomes one of understanding net transport of suspended matter, a process related to advective and diffusive fields within the water column. Understanding of these processes requires an analysis of the velocity field and its driving mechanisms.

ACCESS # : 414, ARL

CITATION : Muench, R.D., J.D. Schumacher, and R.B. Tripp. 1979. Norton Sound/Chukchi Sea oceanographic processes (N-COP). Principal Investigators' Reports for the Year Ending March 1979. Vol. VIII. pp. 288-309. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Sediments; Tides; Transport; Oil pollution; Water pollution; Petroleum development; Oceanography.

SYNOPSIS : Continuing analysis of field data obtained during prior years is enhancing understanding of flow in the northern Bering Sea, particularly with regard to subtidal fluctuations. Five current meter moorings deployed during summer 1978 yielded data which will help clarify both the regional tides and some aspects of subtidal circulation in the region between Norton Sound and St. Lawrence Island. These data are being provided as necessary input to the tidal modelling effort. Further analysis of the existing field data will address regional tidal behavior and propagation/forcing of subtidal flow events through the system. This study will provide estimates of the trajectories likely to be followed by spilled oil and will furnish an indication of dispersion rates for such oil. Oil introduced into the environment via long-term or chronic leakage is more likely to be dispersed throughout the water column and, possibly scavenged by suspended particulate matter. The problem then becomes one of understanding net transport of suspended matter, a process related to the advective and diffusive fields within the water column. An understanding of these processes requires, in turn, analysis of the velocity field and its driving mechanisms.

ACCESS # : 415, RAS-UAF

CITATION : Nunes, P., and P.E. Benville, Jr. 1979. Uptake and depuration of petroleum hydrocarbons in the Manila clam Tapes semidecussata Reeve. Bull. Environ. Contain. Toxicol. 21(6): 719-726.

KEY-WORDS: Clams; Petroleum; Hydrocarbons; Cook Inlet; Toxicity; Absorbance.

SYNOPSIS : The extent to which 6 monocyclic aromatics: benzene, toluene, ethyl benzene, p-xylene, m-xylene, and o-xylene of the WSF of Cook Inlet, Alaska, crude 011 were accumulated and retained by the Manila clam (Tapes semidecussata) was investigated. The clams were exposed to a mean concentration of 3.1 ppm of the 6 monocyclics for 8 d. Subsamples were analyzed every 48 hr for their aromatic content, and after 8 d the remaining clams were transferred to uncontaminated holding tanks and allowed to depurate. Five of the monocyclics were detected in the water, 4 accumulated in the clam tissue, and none were detected in the controlsamples. Since the concentration of p-xylene was below the detectability level of the method used, it was not found in the water or the clams. Benzene had the highest concentration in the water but it was not detected in the clam tissue samples. A constant increase in the hydrocarbon content of the clam tissues was not observed; microbial action on the hydrocarbons may have been responsible for the variations.

ACCESS #: 416, RAS-UAF

CITATION : Naidu, A.S., H.M. Feder, and S.A. Norrell. 1978. The effect of Prudhoe Bay crude oil on a tidal-flat ecosystem in Port Valdez, Alaska. in: Proceedings Tenth Annual Offshore Technology Conference, Houston, TX. May 8-11. Vol. 1. pp. 97-104.

KEY-WORDS: Oil pollution; Sediments; Ecosystems; Tidal flats; Heavy metals; Copepod,

SYNOPSIS : The tidal flat sediments of Port Valdez display significant lateral variations in lithological, chemical, and biological subfacies. The glacially derived deposits are organically low, poorly sorted gravels to clays, with admixtures of sand and silt. Summer bacterial counts are relatively low with 243 aerobic colony forming units (CFU) and 30 anaerobic CFU per gram times 10 of sediment. Meiofaunal species are restricted to the upper 3-cm oxygenated sediment layers, and consist primarily of nematodes and harpacticoid copepods. Simulated crude oil spills in an oxic muddy site resulted in no changes in sediment organic carbon and in the dissolved oxygen contents. Bacterial populations were also not significantly affected by application of up to 2000 ppm of crude oil for several days at a series of low tides. The general lack of organic carbon and bacterial change in oiled sediments may be attributed to the rapid removal of oil from tidal flat surfaces. Harpacticoid copepods were not adversely affected by crude oil; on the other hand, a significant increase in density of one species (Halectinosoma gothiceps) was noted at chronic oil dosages. Nonetheless, a significant decrease in the concentrations of Cu, Zn, Ni, and V has been observed in the tidal deposits, subsequent to the oiling of the sediments.

ACCESS # : 417, RAS-UAF

CITATION : O'Brien, W.J. 1978. Toxicity of Prudhoe Bay crude oil to Alaskan arctic zooplankton. Arctic 31: 219-228.

KEY-WORDS: Oil pollution; Oil spill; Toxicity; Zooplankton; Arctic; Crustacea; Copepod; Prudhoe Bay.

SYNOPSIS : Bioassay experiments were conducted to determine the relative susceptibilities of three arctic zooplankton species to oil pollution, and the results were compared with the effects of an actual oil spill on a pond near Barrow. In both the bioassays and the pond, the addition of Prudhoe Bay crude oil was toxic to fairy shrimp (*Branchionecta paladosa*), which seemed most sensitive, *Daphnia middendorffiana*, which was next most susceptible, and *Heterocope septentrionalis* which appeared somewhat resistant to the effects of oil. Cyclopoid copepods were the only common zooplankters able to survive the pond oil spill, and these were still present two and one half weeks after the spill. The rapid deaths of the other species, especially the branchiopods, suggest that zooplankton may be the most susceptible of all arctic freshwater organisms to oil pollution.

ACCESS # : 418, PMEL

CITATION : Schumacher, J.D. and R.K. Reed. 1983. Interannual variability in the abiotic environment of the Bering Sea and Gulf of Alaska. W. Wooster (ed.). Univ. Washington Sea Grant Contrib. #647. PMEL. (in press)

KEY-WORDS: interannual variability; Oceanography.

SYNOPSIS : Connections between the abiotic and biotic environments are hypothesized for the Bering Sea and for the Gulf of Alaska. Key features of the abiotic environment are first described. After establishing mean or typical conditions, interannual signals which may indicate year-to-year survival of organisms are emphasized. Further research and strategies are identified which may enhance an understanding of the abiotic environment and its relation to biota.

ACCESS # : 419, ARL

CITATION : Patten, B.G. 1977. Sublethal biological effects of petroleum hydrocarbon exposures: fish. In: D.C. Malins (ed.), Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. Vol. 2: Biological Effects. Academic Press, New York, NY. pp. 319-335.

KEY-WORDS: Fish; Oil pollution; Hydrocarbons.

SYNOPSIS : Information is presented on the behavioral and physiological responses of marine fishes to petroleum hydrocarbons at sublethal concentrations. Of major concern are marine species indigenous to arctic and subarctic waters since this information is meager, data on organisms from other geographic environments are included to demonstrate effects that may generally relate to a variety of species.

ACCESS # : 420, ARL

CITATION : Pearson, J.D. 1976, Sublethal Effects - Effects on Sea Grass. Principal investigators? Reports for the Year Ending March 1976. Vol. 8. pp. 377-389. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Toxicity; Food web; Eelgrass; ice; Photosynthesis; Primary production.

SYNOPSIS : This study is directed at evaluating the effects of selected petroleum hydrocarbons (dodecane, toluene, and naphthalene) on rates of photosynthesis in Zostera marina. Since Z. marina is a major contributor to primary production in many ecological niches along the Alaskan coastline, it is imperative to understand the possible effects of exposing it to low-levels of the more water soluble and toxic components of petroleum. Deleterious effects on sea-grass could disrupt whole food chains.

ACCESS # : 421, ARL

CITATION : Percy, J.A. 1977. Effects of dispersed crude oil upon the respiratory metabolism of an Arctic marine amphipod, Onisimus (Boekisimus) affinis. In: D.A. Wolfe (ed.), Fate and effects of petroleum hydrocarbons in marine ecosystems and organisms. Pergamon Press. New York, N.Y. pp. 192-200.

KEY-WORDS: Respiration; Amphipods; Oil pollution.

SYNOPSIS : Short-term lethality is an unsuitable criterion for assessing the ecological effects of pollutants. A variety of sublethal physiological effects may impair an organism's ability to function normally and lead to a reduction or elimination of sensitive populations in a polluted area. The effects of exposure to sublethal concentrations of dispersed crude oil upon the respiratory metabolism of a marine amphipod have been examined. At low oil concentrations metabolism is significantly depressed, but with increasing concentration a reversal of the response occurs. A possible explanation for this complex response is presented. The effects of other factors, such as oil type, presence of dispersants, nutritional state of the animals and weathering of the oil upon the metabolic response are also considered.

ACCESS # : 422, PMEL

CITATION : Schumacher, J.D., and P.D. Moan. 1983. Circulation and hydrography of Unimak Pass and the shelf waters north of the Alaska Peninsula. NOAA Technical Memorandum ERL PMEL-47. Pacific Marine Environmental Laboratory, Seattle, WA. 75 pp.

KEY-WORDS: Circulation; Hydrography; Unimak Pass; Alaska Peninsula; Currents; Oceanography.

SYNOPSIS : Wind, current, bottom pressure, and hydrographic observations from Unimak Pass and the adjacent shelf are presented. Mean flow was from the Gulf of Alaska into the Bering Sea and resulted from the Kena Current. Shorter period fluctuations were bi-directional and coherent with divergence along the coast. Observations along the northern side of the Alaska Peninsula indicated Kena Current water had an impact on the local salt content in the coastal domain, and together with freshwater discharge maintained a stronger horizontal density gradient in the vicinity of the 50-m isobath. Wind forcing, manifested both as coastal divergence and as a source of strong mixing, was evident at shorter periods. Results substantiated previous studies, but they also revealed subtle features including impact of freshwater discharge not associated with gaged rivers, importance of gaps in the mountains to the generation of pressure gradient winds, and the nature of processes which destroy and establish the inner front and the typically two-layered middle shelf domain structure.

ACCESS # : 423, ARL

CITATION : Percy, J.A. 1978. Effects of chronic exposure to petroleum upon the growth and molting of Juveniles of the arctic marine isopod crustacean Mesidotea entomon. J. Fish. Res. Bd. Can. 35: 650-656.

KEY-WORDS: Oil pollution; Growth; Molting; Arctic; isopod; Invertebrates.

SYNOPSIS : Juveniles of the benthic marine isopod Mesidotea entomon were chronically exposed to different concentrations of water-soluble fractions of fresh and weathered Norman Wells crude oil and of fresh Pembina crude for 160 d. The 100% extracts contained 1.72, 1.12, and 0.56 ppm of oil (determined fluorimetrically), respectively. Most of the animals completed five or six molts before the end of the experiment. Long-term mortality was high in the 100% extracts of the oils (LT_{50} = 17, 17, 41 d, for Norman Wells, Pembina, and weathered Norman Wells, respectively) but most of the animals molted at least once before dying. None of the deaths occurred in conjunction with the molt. Stimulation of the onset of the subsequent molt occurred in some exposure groups. A significant increase in the duration of the intermolt period only occurred at the highest oil concentrations. Effects on growth were slight at concentrations lower than that which is lethal during chronic exposure. Exposure to fresh Norman Wells crude depressed growth slightly, while Pembina crude slightly stimulated growth. Weathered Norman Wells severely inhibited growth at the highest concentration but stimulated growth slightly at lower concentrations.

ACCESS # : 424, RAS-UAF

CITATION : Percy, J.A. 1977. Effects of crude oil on the locomotory activity of arctic marine invertebrates. Mar. Poll. Bull. 8(2): 35-40.

KEY-WORDS: Oil pollution; Invertebrates; Amphipods; Arctic; Crustacea; Toxicity.

SYNOPSIS : The effects of exposure to seawater dispersions of northern crude oils on the locomotory activity of two Arctic marine invertebrates, the amphipod Onisimus affinis and the coelenterate Halitholus cirratus have been examined. Low concentrations of the oils significantly impair activity in both species. Exposure to light dispersions of oil, containing 50 microliters of oil per liter seawater for 24 hours reduced activity for both organisms by about 45%; exposure to a dispersion of 500 microliters per liter seawater resulted in activity depressions of 78 to 96% in Onisimus and 55% in Halitholus; exposure to 2000 microliters oil per liter seawater resulted in 98% and 100% reduction in activity, respectively. The manner in which oil interferes with locomotory activity is not known.

ACCESS # : 425, RAS-UAF

CITATION : Rattner, B.A. W.C. Eastin, Jr. 1981. Plasma corticosterone and thyroxine concentrations during chronic ingestion of crude oil in mallard ducks (*Anas platyrhynchos*) *Comp. Biochem. Physiol. C: Comp. Pharmacol.* 68(2): 103-107.

KEY-WORDS: Oil pollution; Waterfowl; Physiology.

SYNOPSIS : The morphological responses and alterations in tolerance which accompany oil exposure in ducks have been attributed to activation of the hypophyseal-adrenal axis by nonspecific stress. A preliminary assessment of adrenal and thyroid function was conducted in 150 mallard ducklings chronically exposed to various dietary quantities of crude oil. The diets consisted of untreated mash, mash mixed with 0.150 percent South Louisiana crude oil, and mash mixed with 0.015, 0.150, and 1.500 percent Alaska Prudhoe Bay crude oil. Blood samples were collected from the ducks after 6, 12, and 18 weeks of the dietary treatments. At week 6, the plasma corticosterone values from birds in the 0.150 percent South Louisiana crude oil and the 0.015 percent Prudhoe Bay crude oil treatment groups were similar to control group levels; however, at weeks 12 and 18 mean plasma corticosterone concentrations in these treatment groups appeared to be somewhat reduced. Dietary exposure to the higher levels of Prudhoe Bay crude oil exposure uniformly reduced mean corticosterone values at all sampling times. Plasma thyroxine concentrations were not significantly altered in ducks in any of the treatment groups. Although the aliphatic components quantified in the crude oils were relatively similar in concentration, the concentrations of aromatics which were analyzed were generally greater in the Prudhoe Bay samples than in the South Louisiana crude oil perhaps accounting for the differences in the effects of equal concentrations of the two crude oils on corticosterone levels.

ACCESS # : 426, ARL

CITATION : Reichert, W.L. 1979. Behavioral and physiological effects induced by sublethal levels of heavy metals. Final Reports of Principal investigators. Vol. 5. pp. 225-240. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Heavy metals; Water pollution; Physiology; Sublethal effects; Cadmium; Lead; Behavior,

SYNOPSIS : The physiological and behavioral effects of cadmium, chromium, lead, and nickel on marine organisms under saline conditions are reviewed. The effects of metals on physiological responses of marine organisms are dependent on the temperature and salinity of the marine environment. In general, physiological effects of heavy metals increase with increasing temperature and decreasing salinity. The sparse literature on the physiological and behavioral effects of lead, cadmium, nickel, and chromium presently provides insufficient background for balanced judgments relating to acceptable levels of these metals in the marine environment.

ACCESS # : 427, ARL

CITATION : Rice, S.D., and J.F.Karinen. 1976. Acute and chronic toxicity, uptake and depuration, and sublethal metabolic response of Alaskan marine organisms to petroleum hydrocarbons. Principal Investigators' Reports for the Year Ending March 1976. Vol.8. pp. 25-47. OCSEAP/NOAA, Boulder," CO

KEY-WORDS: Oil pollution; Ecology; Metabolism; Toxicity; Fishes; Crabs; Crustacea.

SYNOPSIS : This study was designed to determine the acute and chronic toxicity of crude oil and its component-fractions on physiological and behavioral mechanisms of selected arctic and subarctic organisms in laboratory and field studies. Temperature has little effect on toxicity, so that data generated at 12 degrees C can be extrapolated to colder climates. Oil exposures stimulate metabolism in fish, rather than depress metabolism as in crabs.

ACCESS # : 428, ARL

CITATION : Rice, S.D., and J.F.Karinen. 1979. Lethal and sublethal effects on selected Alaskan marine species after acute and long-term exposure to oil and oil components. Principal Investigators' Reports for the Year Ending March 1979. Vol. VI. pp. 27-59. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Toxicity; Petroleum development; Physiology; Temperature; Salinity.

SYNOPSIS : The FY 1977 program involves physiological and bioassay tests of applied research on species indigenous to the Gulf of Alaska, Bering Sea, and Beaufort Sea. The major emphasis of research has shifted from strictly descriptive acute toxicity determinations to mechanistic studies, sublethal tests, and long-term exposures that will eventually allow prediction of oil impact on the biota. Because low temperature appears to be such an important factor in governing the sensitivity of some subarctic species to oil it is necessary to determine whether this relationship holds for similar arctic species in general. A base of information has now been accumulated on acute toxicity, sublethal effects, relative toxicity of oil aromatics, effects of various environmental factors on these parameters, and effects on larvae; but this is only a small part of the information needed to predict and evaluate the major impacts of hydrocarbons in the marine environment. This study has given more knowledge about the effects of temperature and salinity on the ability of subarctic organisms to metabolize, eliminate or recover from petroleum exposure.

ACCESS # : 429, ARL

CITATION : Rice, S.D., J.F. Karinen, and S. Kern. 1978. Acute and chronic toxicity, uptake and depuration, and sublethal response of Alaska marine organisms to petroleum hydrocarbons. NOAA Technical Memorandum ERL OCSEAP-1. Marine Biological Effects of OCS Petroleum Development. pp. 11-24.

KEY-WORDS: Oil pollution; Physiology; Toxicity; Fish; Sublethal effects.

SYNOPSIS : Oil effects studies at the Auke Bay Laboratory began in late 1971, yet this report describes progress associated with OCSEAP funding which began in the last 2 months of FY 75, and draws primarily from published or drafted manuscripts. The studies can be broken down into two basic themes: (1) Toxicity challenge experiments, where an attempt is made to identify sensitive species, life stages, factors that affect toxicity, or components that are most responsible for toxicity; and (2) sublethal physiological response, where an attempt is made to identify, measure, and characterize physiological responses that are indicative of oil stress. Results from the series of sublethal effects studies may have application to monitoring effects of oil and defining the mode of action of toxicants.

ACCESS # : 430, PMEL

CITATION : Baker, E.T. 1983. Suspended particulate matter distribution, transport, and physical characteristics in the North Aleutian Shelf and St. George Basin lease areas. Draft Final Report. 134 pp. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Sediments; North Aleutian Shelf; St. George Basin; Resuspension; Oil pollution; Particulate matter.

SYNOPSIS : The principle objective of this research unit was to describe the distribution, transport, and physical characteristics of suspended particulate matter (SPM) in the area of the North Aleutian Shelf (NAS) and St. George Basin (SGB). The oceanographic conditions which result in the creation of hydrographic structural domains and frontal regions also creates characteristic SPM distributions in each of these domains. A high turbidity surface layer resulted from phytoplankton growth and river derived particles and a bottom layer of increased turbidity due to resuspension of bottom sediments were typical, with frontal zones being sites of increased horizontal particle concentration gradients. The offshore gradient of mean particle concentration fell rapidly from shore to about the 50-m isobath, and then varied little with increasing water depth. Area distribution maps depict an SPM distribution in which particles from point sources along the coast are largely retained in the nearshore zone and dispersed parallel to the coast. Maximum concentrations of particulate-associated oil resulting from an oil spill in NAS waters was estimated to be 0.7-7 ppb in the water column of the nearshore zone (10-20 m deep) and 0.06-1.1 ppb in the offshore zone (40-90 m deep). Sedimentation of this oil to the benthos, calculated on the basis of sediment trap data, could be expected to be in the range of 1-10 mg oil/m²/day.

ACCESS # : 431, ARL

CITATION : Rice, S.D., S. Kern, C.C. Brodersen, S.A. Lindsay, and S.A. Andrews. 1981. Toxicity of ballast-water treatment effluent to marine organisms at Port Valdez, Alaska, Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup). March 2-5, 1981, Atlanta, Georgia.

KEY-WORDS: Toxicity; Oil pollution; Aromatic hydrocarbons; Salmon; Shrimp.

SYNOPSIS : Approximately 12 million gallons of oily ballast water is taken ashore and treated daily at the Alyeska treatment plant, where tankers take on crude oil at the terminus of the Trans-Alaska pipeline near Valdez, Alaska. Most oil is removed, but some light aromatic hydrocarbons (1 to 16 parts per million) remain in the large volume of discharged effluent. Between May and July, the concentration of aromatic hydrocarbons in the treated effluent (measured by gas chromatography) generally declined as the seasonal temperatures increased. We measured the toxicity of the effluent on site at Valdez. For the larvae of crustaceans and of fish the median lethal concentration LC_{50} was between 10 and 20 percent of treated effluent in 96-h static tests. For salmon fry and shrimp in repeated acute flow-through assays, the LC_{50} was quite consistent, between 20 and 40 percent of treated effluent. Because the concentration of aromatic hydrocarbons was much lower in the later tests, but the toxicity of the effluent was not lower, toxicants other than aromatic hydrocarbons must contribute significantly to the toxicity of the effluent from the ballast-water treatment plant.

ACCESS # : 432, ARL

CITATION : Rice, S.D., S. Kern, and J.F. Karinen. 1977. Lethal and sublethal effects on selected Alaskan marine species after acute and long-term exposure to oil and oil components. Annual Reports of Principal investigators for the Year Ending March 1977. Vol. 12. pp. 23-43. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Shellfish; Physiology.

SYNOPSIS : Laboratory and field studies were conducted to determine recovery rates of selected organisms and ecosystems from perturbations resulting from either contamination or other disturbances associated with petroleum development. The research involved physiological and bioassay tests of applied research on species indigenous to the Gulf of Alaska, Bering Sea, and Beaufort Sea. The major emphasis of research has shifted from strictly descriptive acute toxicity determinations to mechanistic studies and sublethal tests that will eventually allow prediction of oil impact on the biota. Studies to determine the acute toxicity of the water-soluble fraction (WSF) of crude oil continue with experiments with species not tested previously. Methodology and apparatus of flow-through tests have been designed and three systems are in use. Experiments also continue with larvae of species not tested previously. Emphasis is on intertidal species, such as mussels, barnacles, snails, and sea urchins.

ACCESS # : 433, ARL

CITATION : Rice, S.D., S. Kern, and J.F. Karinen. 1978. Lethal and sublethal effects on selected Alaskan marine species after acute and long-term exposure to oil and oil components. Final Reports of Principal Investigators for the Year Ending March 1978. Vol. 1. pp. 1-32. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Toxicity; Sublethal effects; Physiology.

SYNOPSIS : The research involves physiological and bioassay tests of applied research on species indigenous to the Gulf of Alaska, Bering Sea, and Beaufort Sea. The major emphasis has shifted from strictly descriptive acute toxicity determinations to mechanistic studies and sublethal tests that will eventually allow prediction of oil impacts on the biota. The studies have two basic themes. Toxicity challenge experiments, where sensitive species, live stages, factors that affect toxicity, or components that are most responsible for toxicity are identified; and sublethal physiological response, where physiological responses that are indicative of oil stress are identified, measured, and characterized.

ACCESS # : 434, ARL

CITATION : Rice, S.D., S. Kern, and J.F. Karinen. 1980. Lethal and sublethal effects on selected Alaskan marine species after acute and long-term exposure to oil and oil components. Annual Reports of Principal Investigators for the Year Ending March 1980. pp. 1-12. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Benthos; Food Web; Biological degradation; Sea ice.

SYNOPSIS : Although direct comparisons of arctic and subarctic animal sensitivity are difficult due to different bioassay methods used, arctic animals appear to be equal in sensitivity to oil as subarctic animals. The fish were more sensitive than the invertebrates and were comparable to pink salmon (subarctic species). Arctic animals were highly adaptable to temperature changes, although there were no effects of temperature on sensitivity of arctic animals to oil. Results indicate little difference in sensitivity of arctic and subarctic animals to oil. Lower environmental temperatures in the arctic would result in oil persisting longer after a spill due to lower volatility and biodegradation of oil components and because oil would become trapped or immobilized in ice. There are fewer species in the arctic and food chains are very short. If a species is affected, there would be few replacement species. The arctic habitat is more vulnerable, and once changed, less able to adjust. Even though individual species are generally very hardy and tolerant of natural environmental extremes and limited amounts of pollution.

ACCESS # : 435, ARL

CITATION : Rice, S.D., S. Kern, and J.F. Karinen. 1979. Lethal and sublethal effects on selected Alaskan marine species after acute and long-term exposure to oil and oil components. Annual Reports of Principal Investigators for the Year Ending March 1979. Vol. 6. pp. 27-59. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Larvae.

SYNOPSIS : The FY 1979 program involves physiological and bioassay tests of applied research on species indigenous to the Gulf of Alaska, Bering Sea, and Beaufort Sea. The major emphasis of research has shifted from strictly descriptive acute toxicity determinations to mechanistic studies, sublethal tests, and long-term exposures that will eventually allow prediction of oil impact on the biota. Because low temperature appears to be such an important factor in governing the sensitivity of some subarctic species to oil it is necessary to determine whether this relationship holds for similar arctic species or arctic species in general. A base of information has now been accumulated on acute toxicity, sublethal effects, relative toxicity of oil aromatics, effects of various environmental factors on these parameters, and effect on larvae, but this is only a small part of the information needed to predict and evaluate the major impacts of hydrocarbons in the marine environment. This study has given more knowledge about the effects of temperature and salinity on the ability of subarctic organisms to metabolize eliminate or recover from petroleum exposure.

ACCESS # : 436, ARL

CITATION : Rice, S.D., A. Moles, T.L. Taylor, and J.F. Karinen. 1979. Sensitivity of 39 Alaskan marine species to Cook Inlet crude oil and No. 2 fuel oil. Proceedings: 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup). March 19-22, 1979. Los Angeles, Ca. pp. 549-554.

KEY-WORDS: Toxicity; Fishes; Bivalves; Bioassay; Invertebrates.

SYNOPSIS : The sensitivities of 39 subarctic Alaskan species of marine fish and invertebrates to water-soluble fractions of Cook Inlet crude oil and No. 2. fuel oil were determined. This is the largest group of animals ever tested under similar test conditions with the same petroleum oils and analytical methods. Organisms bioassayed represent several habitats, six phyla, and 39 species including fish (9), arthropods (9), mollusks (13), echinoderms (4), annelids (2), and nemerteans (2). Sensitivities were determined by 96-h static bioassays. Concentrations of selected aromatic hydrocarbons were determined by gas chromatography; concentrations of paraffins were determined by infrared spectrophotometry. Although sensitivity generally increased from lower invertebrates to higher invertebrates, and from higher invertebrates to fish, sensitivity was better correlated to habitat. Pelagic fish and shrimp were the most sensitive animals to Cook Inlet crude oil. Sensitive pelagic animals are not necessarily more vulnerable to oil spills than tolerant intertidal forms--oil may damage intertidal environments more easily and adverse effects may persist longer than in damaged pelagic environments.

ACCESS # : 437, ARL

CITATION : Rice, S.D., R.E. Romas, and J.Vi. Short. 1976. Effect of petroleum hydrocarbons on breathing and coughing rate and hydrocarbon uptake-depuration in pink salmon fry. Principal Investigators? Reports for the Year Ending March 1976 Vol. 8. pp. 88-118. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Toxicity; Salmon; Aromatic hydrocarbons; Physiology,

SYNOPSIS : Pink salmon fry, Oncorhynchus gorbuscha, were exposed to the water-soluble fraction of Cook Inlet and Prudhoe Bay crude oils, and No. 2 fuel oil. During 22 h exposures, breathing and coughing rates initially increased as the dose increased but then decreased after several hours. Breathing and coughing rates increased significantly during exposures to oil concentrations as low as 30% of the 96 h median tolerance limit as determined by ultraviolet spectroscopy. It is speculated that the increased respiration rate reflects an increased energy demand for enzyme synthesis. Chronic exposure requiring elevated energy demands may be detrimental to the survival of a population.

ACCESS # : 438, ARL

CITATION : Schneider, D.E. 1980. Physiological responses of arctic epibenthic invertebrates to winter stresses and exposure to Prudhoe Bay crude oil dispersions. Annual Reports of Principal investigators for the Year Ending March 1980. Vol. 1. pp. 413-475. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Toxicity; Invertebrates.

SYNOPSIS : One of the most serious environmental challenges faced by arctic shallow-water animals is the seasonal variation in salinity. Many of the arctic shallow water epibenthic invertebrates are euryhaline. However, the upper salinity limits for survival and spontaneous locomotion for many species are approached in the deeper waters of lagoons during late winter and spring. To avoid these stressful conditions it is predicted that many of the species will migrate from lagoons during the winter. This prediction is supported by the seasonal distribution data by mysids (Mysis littoralis, Anonyx nugax and Boeckosimus affinis). Exposure of epibenthic invertebrates to Prudhoe Bay crude oil dispersion has shown that three of the most common species are sensitive to oil, particularly at elevated salinities where the animals may already be experiencing stress from that factor. An oil spill during the winter months may have more serious impact than one during a season with less stressful salinity regime.

ACCESS # : 439, ARL

CITATION : Schneider, K.B. 1976. Assessment of the distribution and abundance of sea otters along the Kenai Peninsula, Kamishak Bay and the Kodiak Archipelago. Principal Investigators' Reports for the Year Ending March 1976. Vol. 1. pp. 333-358. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Marine mammals; Oil pollution; Sea otter; Distribution.

SYNOPSIS : Aerial and boat surveys were conducted around the Kenai Peninsula and the Kodiak Archipelago to determine the present distribution and relative abundance of sea otters. Sea otter populations in these areas are relatively small but are expanding their range. The potential for adverse impacts of OCS activities on sea otters appears high. Sea otters are more vulnerable to direct oiling than any other species of marine mammal and they may be indirectly affected by chronic low levels of pollution through the food chain. Where populations are expanding their range, a localized influence could retard repopulation of large areas. Sea otters exert a significant impact on nearshore marine communities. It is necessary to consider the history of sea otter occupation of an area when studies of these communities are conducted. Information being gathered under this project will be used to trace the patterns of range expansion, predict future trends, identify those areas where OCS activities would have greatest impact on the population and provide a basis for evaluating the sea otter's role in changes in marine communities.

ACCESS # : 440, ARL

CITATION : Smith, D.D., and G.H. Holliday. 1979. API/SC-PCO Southern California 1978 oil spill test program. Proc. Oil Spill Conference. 19 March 1979. American Petroleum Institute-Washington, DC. pp. 475-482.

KEY-WORDS: Oil pollution.

SYNOPSIS : Using Alaskan crude in a special offshore test zone authorized by an EPA Research Ocean Dumping Permit, API/SC-PCO generated a series of small oil slicks for testing dispersant application methods and mechanical cleanup equipment in late September 1978. Seven test slicks ranging from 5 to 20 bbl were sprayed with low-toxicity dispersants using a helicopter, a crop-dusting monoplane, and two types of boat-mounted spray systems. A Cyclonet 100 centrifugal skimmer was tested on an eighth slick. In addition, a capsule demonstration in which four one-barrel slicks were generated and dispersed provided agencies, media, and the public the opportunity to witness the use of dispersant at close range. The technical operational testing was supplemented by detailed chemical and biological monitoring studies and by extensive motion picture and air photographic coverage. Field observations and photographic documentation indicate that: the two dispersant application techniques tested are all viable methods for applying dispersant to oil spills at sea and the Cyclonet recovered oil, but the test slick was too small to assess probable performance in a major spill situation.

ACCESS # : 441, ARL

CITATION : Smith, R.L., and J.A. Cameron. 1977. Acute effects - Pacific herring roe in the Gulf of Alaska. Principal Investigators' Reports for the Year Ending March 1977. Vol. 12. pp. 596-635. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oilpollution; Fishes; Pacific herring roe; Hydrocarbons; Herring.

SYNOPSIS : The potential impact of OCS oil development activities on a single species of Alaskan marine fish, the Pacific herring (*Clupeaharengus pallasii*) was evaluated. This project sought to simulate conditions of a crude oil spill to test the effects of low boiling point, water-soluble hydrocarbon components of Prudhoe Bay crude on developing herring larvae. Exposure for as little as 48 hrs. led to a significantly higher incidence of gross morphological abnormalities. Exposure for six days resulted in 100% mortality in the fertilized embryos. The following conclusions were reached: the herring reproductive cycle is vulnerable to oilpollution for at least two months, possibly more; very low hydrocarbon levels produced significant effects in terms of hatching success, gross morphological abnormalities total larval length, and presence of hydrocarbons in hatched larvae and unhatched embryos; and deleterious effects produced by oil contamination reduce the fitness of larvae which, at best, had little chance to survive to adulthood.

ACCESS # : 442, ARL

CITATION : Smith, R.L., and J.A. Cameron. 1979. Effect of water-soluble fraction of Prudhoe Bay crude oil on embryonic development of Pacific Herring. Trans. Amer. Fish. Soc. 108: 70-75.

KEY-WORDS: Oilpollution; Fishes; Toxicity; Mortality; Juveniles; Herring; Reproduction.

SYNOPSIS : This project sought to simulate conditions of a crude oil spill to test the effects of low boiling point, water-soluble hydrocarbon components of Prudhoe Bay crude oil on developing Pacific herring embryos. Initial hydrocarbon concentrations in the experimental containers were less than 1 microgram/g H₂O. Exposure for 48 hours led to a significantly higher incidence of gross morphological abnormalities. Exposure for 6 days resulted in 100% mortality of the fertilized embryos. Gross abnormalities usually consisted of flexures in the body which reduced or prevented locomotion. Results of scanning electron microscopy reveal other defects, such as improperly formed mouths, which adversely affect biological fitness yet are difficult to detect. Exposure for 12 h or longer led to reduced size of newly hatched larvae, suggesting hydrocarbon exposure adversely affects embryonic metabolism.

ACCESS # : 443, ARL

CITATION : Smith, R.L., J.G. Pearson, and J.A. Cameron. 1976. Acute effects - Pacific herring roe in the Gulf of Alaska. Principal Investigators' Reports for the Year Ending March 1976. Vol. 8. pp. 325-343. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Pacific herring roe; Fisheries; Mortality; Larvae; Infertility.

SYNOPSIS : The objective of this study is to delineate the toxicity of soluble components of crude oil under simulated natural conditions. Toxicity is measured in terms of hatching success and gross morphological abnormalities. Herring spawn in a habitat which is particularly susceptible to the influence of crude oil. Many of the roe are deposited in the intertidal, the larger usually being deposited highest on the beach. Since the larger eggs normally produce the larvae with the greatest chance of reaching adulthood, the presence of oil on the water and on the beach will select against the highest quality of eggs in particular and will cause an increased mortality in general. Spills or seepage during the three to four week reproductive period could have significant impact on egg and larval mortality. These mortality rates are already high in nature. Development activities could have a major impact on the herring fishery in Alaska.

ACCESS # : 444, ARL

CITATION : Smith, R.L., A.C. Paulson, and J.R. Rose. 1976. Food and feeding relationships in the benthic and demersal fishes of the Gulf of Alaska and Bering Sea. Principal investigators' Reports for the Year Ending March 1976. Vol. 7. pp. 471-508. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Benthos; Demersal fish; Food habits; Commercial fisheries.

SYNOPSIS : The ultimate goal is to construct a detailed picture of the food and feeding relationships of the fishes in the Gulf of Alaska and Bering Sea. This will include analyses of predator size vs. prey composition; bottom type, temperature and location vs. prey composition; prey composition in diets vs. prey abundance; prey composition vs. season. The rationale behind this study is to develop an ability to predict the impact of oil development activities on the fishes. This study, coupled with others designed to study acute and chronic toxic effects on the fish populations, will establish the predictive base necessary to make management decisions.

ACCESS # : 445, ARL

CITATION : Smith, R.L., A.C. Paulson, and J.R. Rose. 1978. Food and feeding relationships in the benthic and demersal fishes of the Gulf of Alaska and Bering Sea. 1978. Principal Investigators' Reports for the Year Ending March 1978. Vol. 1. pp. 33-107. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Fishes; Feeding behavior; Oil pollution; Commercially important species.

SYNOPSIS : The rationale behind this study was to develop an ability predict the impact of oil development activities on the fishes in these two areas. The study, coupled with others designed to study acute and chronic toxic effects on the fish populations, will help establish the predictive base necessary to make management decisions. The research findings on pollock, rex sole, rock sole, clover sole, flathead sole, arrowtooth flounder, Greenland halibut, capelin and shortfin mako are discussed. Existing information on Pacific cod, yellowfin sole and Pacific halibut is summarized.

ACCESS # : 446, IMS-UAF

CITATION : Stekoll, M.S., L.E. Clement, and D.G. Shaw. 1977. Sublethal effects of petroleum on *Macoma balthica*. in: Program Review Proc. of: Environmental effects of energy related activities on marine/estuarine ecosystems. Report No. EPA-600/7-77-111 and OEMI-77-025. pp. 1-17.

KEY-WORDS: Oil pollution; intertidal; Sublethal effects; Waterfowl; Bivalves.

SYNOPSIS : The bivalve mollusk *Macoma balthica* has previously been proposed as an indicator of oil pollution. This small clam was selected for study because of its wide distribution and abundance in Alaskan intertidal environments. *Macoma balthica* is a surface deposit feeder and suspension feeder, which would make it likely to concentrate both suspended and stranded oil that might occur following a spill. Such concentrated oil in the clams might be further distributed throughout the ecosystem via migrating birds that feed on *M. balthica*. it was the purpose of this investigation to show that *M. balthica* is able to concentrate oil from an oil-sea water dispersion and to ascertain what effects the oil might have on membrane-bound enzymes and other physical and chemical parameters of the clams.

ACCESS # : 447, RAS-UAF

CITATION : Straughan, D. and D. Hadley. 1978. Experiments with *Littorina* species to determine the relevancy of oil spill data from southern California to the Gulf of Alaska. Mar. Environ. Res. 1(2): 135-163.

KEY-WORDS: Pollution effects; Temperature; Oil pollution; Invertebrates.

SYNOPSIS : *L. scutulata* were collected from Alaska, Canada and southern California and *L. sitkana* were collected from Alaska and Canada. These animals were exposed to a range of petroleums at a range of temperatures. Gasoline was the most toxic of all compounds tested. 6 (degree) C and 29 (degree) C temperatures both during and prior to experiments had a greater influence on survival and attachment rates a week after exposure to petroleum than did the different types of petroleum. The temperature influence can be related to both zoogeographical distribution and seasonal temperatures. Data obtained in the Santa Barbara Channel can be extrapolated to the Gulf of Alaska when differences such as temperature tolerance and type of oil are considered for the same and closely related species. Attachment rates and mortality rates changed after the animals were removed from petroleum. This suggests a weakness in standard toxicity testing procedures when mortality rates are compared immediately after removal from test solutions.

ACCESS # : 448, ARL

CITATION : Taylor, T.L., and J.F. Karinen. 1977. Response of the clam, *Macoma balthica* (Linnaeus) exposed to Prudhoe Bay crude oil as unmixed oil, water-soluble fraction, and oil-contaminated sediment in the laboratory. In: D.A. Wolfe (ed.), Fate and effects of petroleum hydrocarbons in marine organisms and ecosystems. Pergamon Press, New York, NY. pp. 229-237.

KEY-WORDS: Oil pollution; Sediments; Toxicity; Mortality; Predation; Bivalves.

SYNOPSIS : This clam will likely be subjected to oil slicks layered on the mud and to water-soluble fractions (WSF) of crude oil or oil-contaminated sediment. Gentle settling of crude oil over clam beds had negligible effects on clams observed for 2 months. Water-soluble and oil-treated sediment (OTS) fractions of Prudhoe Bay crude oil inhibited burrowing and caused clams to move to the sediment surface. Although short-term exposures of clams to the WSF of crude oil and OTS caused few deaths, behavioral responses of clams to oil may be of great importance to their survival in the natural environment.

ACCESS # : 449, SC UNIVERSITY, COLUMBIA, SC

CITATION : Thomas, R.E. and S.D. Rice. 1977. The effect of exposure temperatures on oxygen consumption and opercular breathing rates of pink salmon fry exposed to Inlet crude oil and No. 2 fuel oil. in: Marine Pollution: Functional Responses. Proc. Symp. Poll. Physiol. Mar. Organ. pp. 39-52.

KEY-WORDS: Salmonid; Aromatic hydrocarbons; Toxicity; Oil pollution; Physiology.

SYNOPSIS: The primary objective of this study was to measure breathing rates in pink salmon fry exposed to equivalent concentrations of aromatic hydrocarbon toxicants at 4 and 12 C to determine if the response at the lower temperature differs from that at the higher temperature. This experiment was of interest because spills in Alaskan waters will probably occur at lower temperatures than have been studied elsewhere, and little is known about the effects of aromatic hydrocarbons at these lower temperatures. There is general agreement that the mononuclear and dinuclear aromatic hydrocarbons are responsible for the toxic effects of water-soluble fractions from crude and refined oils. The toxicity of different oils is influenced by kinds and relative abundance of aromatic hydrocarbons present, and results suggest that those oils with relatively high concentrations of mononuclear aromatic hydrocarbons may be particularly damaging to coldwater fishes in arctic and subarctic environments.

ACCESS #: 450, RAS-UAF

CITATION : Vanderhorst, J.R., C.I. Gibson, and L.J. Moore. 1976. Toxicity of No. 2 fuel oil to Coon Stripe Shrimp. Mar. Poll. Bull. 7(6): 106-108.

KEY-WORDS: Shrimp; Oil pollution; Toxicity; Bioassay.

SYNOPSIS : The objective in this study was to measure short-term (96 h) lethal toxicity of a No. 2 fuel oil-in-seawater dispersion to coon stripe shrimp (*Pandalus danae*) under continuous flow conditions. A useful starting point in assessing the effects of contaminating materials is by determining short-term lethal concentrations. The bioassay of petroleum and refined oils has resulted in highly divergent and apparently contradictory findings with respect to short-term lethal effects. Bioassay of a No. 2 fuel oil dispersion with shrimp in a continuous flow system using measured waterborne oil as the indicator of oil concentrations reveals a treatment more definable than those previously described in terms of volume ratios and produces lower lethal concentrations. Shrimp 96-h LC₅₀ was 0.8 mg/l in this study as compared to values from 1.5 to 50 mg/l reported for other methods. Mean concentrations in tests do not give significant differences in concentration with respect to day of the test or spatial distribution in the exposure tanks.

ACCESS # : 451, NMFS

CITATION : Varanasi, U. 1978. Biological Fate of Metals in Fish. NOAA Technical Memorandum ERL OCSEAP-1. Marine Biological Effects of OCS Petroleum Development pp. 41-53.

KEY-WORDS: Oil pollution; Toxicity; Fishes; Lead; Cadmium; Heavy metals; Salmon.

SYNOPSIS : To obtain the most comprehensive and in-depth evaluation of the impact of trace metals on arctic and subarctic organisms; the investigation was carried out in three separate phases; (1) Biochemical interactions of trace metals in fish which dealt with patterns of uptake, accumulation, and retention of lead and cadmium in key tissues of fish exposed to low levels of water-borne metals at 4 degree and 10 degrees C (Subcellular distribution of metals as well as mechanisms of excretion were also studied); (2) evaluation of importance of skin and epidermal mucus in metabolism and excretion of metals which defines uptake, accumulation and discharge of trace metals from epidermal mucus, skin, and scales of fish; and (3) influence of metal exposure on hydrocarbon metabolism in fish. This study was initiated to assess alterations in the profiles of metabolites of hydrocarbons (e.g. naphthalene) in tissues of fish exposed to lead and cadmium.

ACCESS # : 452, ARL

CITATION : Varanasi, U., and D.C. Malins. 1977. Metabolism of petroleum hydrocarbons: accumulation and biotransformation in marine organisms. In: D.C. Malins (ed.), Effects of petroleum on arctic and subarctic marine environments and organisms. Vol. 2. Academic Press, New York, NY. pp. 175-270.

KEY-WORDS: Metabolism; Oil pollution; Hydrocarbons; Food web.

SYNOPSIS : This chapter covers studies conducted primarily on indigenous species and includes wherever possible, the relatively small amount of data which relate to the influence of environmental conditions (e.g. low temperatures). The review includes discussion of the uptake, metabolism, and discharge of petroleum hydrocarbons in marine organisms exposed to sublethal levels of petroleum. Resultant biochemical alterations in challenged organisms to ascertain overall effects of long-term exposure to sublethal concentrations of petroleum hydrocarbons is discussed. Major emphasis is on laboratory bioassay studies or simulated field experiments. In addition, certain relevant information about concentrations of petroleum hydrocarbons in animals obtained from known areas of petroleum contamination are included. Furthermore, an attempt is made to evaluate the status of knowledge on these subjects and pinpoint areas where information is lacking. It also delineates areas where more work is required to form a cohesive understanding of the biochemical consequences of exposing arctic and subarctic marine species and ecosystems to petroleum.

ACCESS # : 453, ARL

CITATION : Widdows, J., T. Bakke, B.L. Bayne, P. Donkin, D.R. Livingstone, D.M. Lowe, M.N. Moore, S.V. Evans, and S.L. Moore. 1982. Responses of *Mytilus edulis* on exposure to the water-accommodated fraction of North Sea oil. Mar. Biol. 67: 15-31.

KEY-WORDS: Bivalves; Toxicity; Oil pollution; Aromatic hydrocarbons; Physiology; Growth.

SYNOPSIS : Individuals of *Mytilus edulis* L. collected from the Erme Estuary (S.W. England) in 1978, were exposed to low concentrations (7 to 68 ug/l) of the water-accommodated fraction (WAF) of North Sea crude oil. The pattern of accumulation of petroleum hydrocarbons in the body tissue was affected by the presence of algal food cells, the period of exposure, the hydrocarbon concentration in the water, the type of body tissue, and the nature of the hydrocarbon. Many physiological responses (e.g. rates of oxygen consumption, feeding, excretion, and scope for growth), cellular responses (e.g. lysosomal latency and digestive cell size) and biochemical responses (e.g. specific activities of several enzymes) were significantly altered by short-term (4 wk) and/or long-term (5 mo) exposure to WAF. Stress indices such as scope for growth and lysosomal latency were negatively correlated with tissue aromatic hydrocarbons.

ACCESS # : 454, ARL

CITATION : Wiens, J.A.; G. Ford, D. Heinemann, and C. Fieber. 1979. Simulation modeling of marine bird population energetic, food consumption, and sensitivity to perturbation. Principal Investigators! Reports for the Year Ending March 1979 Vol. 1. pp. 217-270. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Petroleum development; Seabirds; Models; Murres; Pribilof Islands.

SYNOPSIS : in the development of models to explore the effects of oil perturbations on breeding seabird colonies, as depicted by the Pribilof Islands' colonies, major attention was given to short-term (within-year) and to long-term (multiyear) effects. This report describes the model structures, analyses, and results for each level of modeling, and discusses the relevance of these exercises for oil-related impacts on colonially-breeding marine birds. Analysis shows that the chronic effects of oil development may be much more damaging than the short-term effects of an oil spill because of the extreme sensitivity of these populations to light changes in annual survival (especially of adults) and in fecundity. in general, the populations should be able to recover from oil spills, although in some cases it may take decades, but a permanent decrease in annual survival or fecundity may push a species over the edge, making it unable to persist on the Pribilofs. This argument is especially germane to Red-legged Kittiwakes, since over 95% of the world population of this species breeds on St. George. In addition, several other seabirds that breed on the Pribilofs are near the edges of their species ranges, increasing the probability that small environmental changes may push them to local extinction on the Pribilofs.

ACCESS # : 455, ARL

CITATION : Holmes, W.N., and J. Cronshaw. 1977. Biological effects of petroleum on marine birds. In: D.C. Malins (ed.), Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. Vol. II. Biological Effects. Academic Press, Inc. New York. NY. pp. 359-398.

KEY-WORDS: Toxicity; Oilspill; Seabirds; Mortality.

SYNOPSIS : Although the very high levels of contamination which occur immediately after a catastrophic spillage may be short-lived, the effects of the petroleum on birds may persist long after the environment has returned to a relatively pristine state. For instance, the estimates of mortality recorded during the first few days after a spill will be derived mainly by counting beached carcasses. No estimate can be made of the number of carcasses that sank or were devoured. During subsequent weeks birds that have been collected into cleansing centers will die and this number must be added to the initial estimates. Since some of the cleansed birds may survive several weeks, data from all sources may not be collected and included in the final estimate. Thus, quite apart from the fact that not all casualties are found, serious inaccuracies may occur during the collection of mortality data from these sources.

ACCESS # : 456, ARL

CITATION : Zimmerman, S.J., and R.R. Merrell, Jr. 1976. Baseline characterization, littoral biota, Gulf of Alaska and Bering Sea. Principal investigators! Reports for the Year Ending March 1976. Vol. 6. pp. 75-484. OCSEAP/NOAA, Boulder, CO

KEY-WORDS: Oil pollution; Distribution; Fishes; Toxicity; Littoral habitats.

SYNOPSIS : A general characterization and survey of the intertidal and shallow subtidal biota in the region from Yakutat in the eastern Gulf of Alaska to Cape Newenham in northern Bristol Bay is provided. Two objectives in the study were: to determine the distribution of the major habitat types (sandy, muddy, rocky, etc.) along the coastline; and to determine the densities and distribution of biotic populations within these habitat types. The distribution of organisms within habitat types is being determined by field parties from the Auke Bay Fisheries Laboratory (ABFL), with logistical assistance from the Pacific Marine Center. Additional projects include an extensive literature survey, a study of the accumulation of biotic debris in the 'drift' zone, the estimation of variability between sampling areas, and more intensive studies at sites which may receive major impact from oil expiration in the eastern Gulf of Alaska. The intertidal and shallow subtidal areas provide one of the major points of contact between floating or dissolved pollutants and the marine substrate. The majority of biota in these areas are non-motile and are unable to avoid repeated exposure as oil or similar compounds come ashore. In addition to the obvious problems of suffocation or acute toxicity, other effects may occur. For instance, removal of littoral populations may cause changes in the feeding patterns of marine birds and mammals. It may also change the reproductive potential of certain marine fishes.

ACCESS # : 457, ARL

CITATION : Malins, D.C. and H.O.Hodgins. 1976. Sublethal effects as reflected by morphological, chemical, physiological, and behavioral indices. Principle Investigators' Reports for July-September 1976. pp. 23-60. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Fishes; Toxicity; Trace metals; Physiology; Feeding behavior; Oil pollution.

SYNOPSIS : The objective of these studies is to identify and evaluate in selected marine organisms the effects of chronic exposure to petroleum hydrocarbons and trace metals. Under the general task objective, physiological, morphological, chemical, and behavioral parameters are being investigated, (1) physiological: effect of ingestion of whole crude oil on reproductive success in salmonids. (2) morphological: effect of ingestion of whole crude oil on structure and ultrastructure of internal tissues of salmonids. (b) changes in skin and gill epitheliums of flatfish and salmon following exposure to the water-soluble fraction (WSF) of crude oil. (3) chemical: evaluate uptake, accumulation, and discharge of trace metals from mucus, epidermis, and scales of salmonids. (4) behavioral: effects of water-soluble fraction of crude oil on feeding behavior of shrimp.

ACCESS # : 458, ARL

CITATION : Kooyman, G.L., R.L. Gentry, and W.B. McAlister. 1976. Physiological impact of oil on pinnipeds. Principle Investigators' Reports for October-December 1976. pp. 3-26. OCSEAP/NOAA, Boulder, Colo.

KEY-WORDS: Fur seals; Oil pollution; Metabolism; Temperature; Marine mammals.

SYNOPSIS : The objective of this study was to measure the effects of oil contamination on the northern fur seal through studies on the thermal conductance of pelts, dive performance, and alterations in the metabolic rate before and after contact with oil. A second objective was to compare thermal conductance in pelts of fur-bearing marine mammals with that of nonfur-bearing species to determine whether surface fouling might be a major route of impact for all species. The study has shown that small amounts of crude oil have large effects on thermal conductance of fur-bearing pelts, and no effect on nonfur-bearing pelts. In living animals light oiling of approximately 30% of the pelt surface area resulted in a 1.5-fold increase in metabolic rate while immersed in water of various temperatures. Furthermore, this effect lasted at least 2 weeks. Although normal diving was measured, we did not obtain post-oiling data to show the effect of oil contact on dive performance.

ACCESS # : 459, ARL

CITATION : Geraci, J.R., and T.G. Smith. 1977. Consequences of 011 fouling on marine mammals. In: D.C. Malins (cd.), Effects of Petroleum on Arctic and Subarctic marine Environments and Organisms. Vol. II. Biological Effects. Academic Press, Inc. New York. NY. pp. 399-410.

KEY-WORDS: Marine mammals; Oil pollution; Seals; Toxicity.

SYNOPSIS : This study showed that up to 75 ml of ingested crude oil is not irreversibly harmful to seals. The liver is generally regarded as a prime target organ for hydrocarbon damage in mammals. The effects of such damage have been well documented. If sufficient quantities of these hepatotoxic substances are administered, liver enzymes are released into plasma and are detectable. The degree and duration of enzyme release is generally a function of the quantity and toxicity of the substance(s). Measurable liver damage in grey seals was induced, using 5 and 10 ml quantities of carbon tetrachloride, a rather potent fraction. In this study there was only transient liver enzyme release. If there was liver damage, it was negligible.

ACCESS # : 460, ARL

CITATION : Szaro, R.C., and P.H. Albers. 1976. Effects of external applications of No. 2 fuel oil on Common Eider eggs. In: D.A. Wolfe (cd.), Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms. Pergamon Press, New York. NY. pp. 164-167.

KEY-WORDS: Toxicity; Oil pollution; Waterfowl.

SYNOPSIS : Because eggs of marine birds may be exposed to oil adhering to the feathers of adult birds, a study was undertaken to determine the effects of oil contamination. Two hundred Common Eider eggs (*Somateria mollissima*) were divided into four experimental sets of 50 each. Two sets were treated with No. 2 fuel oil in amounts of 5 ul and 20 ul; a third with 20 ul of propylene glycol, a neutral blocking agent. The fourth set served as a control. Hatching success was 96 percent for the eggs treated with 5 ul propylene glycol, 96 percent for the controls, and 92 percent for the eggs treated with 5 ul 011 hatched. Only 69 percent of the eggs treated with 20 ul of oil survived: a significant reduction in hatchability (P less than or equal to 0.05). Mean hatching weights for all sets were statistically equal. Thus, oil pollution may significantly increase embryonic mortality in marine birds.

CITATION : Caldwell, R.S., E.M.Caldrone, and M.H.Mallon. 1976. Effects of a seawater-soluble fraction of Cook Inlet crude oil and its major aromatic components on larval stages of the Dungeness crab, *Cancer magister* Dana. in: D.A. Wolfe (ed.), Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms. Pergamon Press, New York, NY. pp. 210-220.

KEY-WORDS: Crustacea; Petroleum; Aromatic hydrocarbons; Naphthalene; Toxicity; Crabs.

SYNOPSIS : Larval stages of the Dungeness crab, *Cancer magister* Dana, were exposed continuously to dilutions of Cook Inlet crude oil water-soluble fraction (WSF) of seawater solutions of naphthalene or benzene for periods lasting up to 60 days. Effects on survival, duration of larval development, and size were employed as indicators of toxic effects. The lowest concentration of the WSF at which toxic effects were seen was 4.0% of the full strength WSF (0.0049 mg/l as naphthalene or 0.22 mg/l as total dissolved aromatics). The lowest concentration at which toxic effects were observed with naphthalene was 0.13 mg/l and with benzene was 1.1 mg/l. The concentration of aromatic hydrocarbons in the WSF were inversely related to the degree of alkylation in each of the benzene and naphthalene families, but the acute toxicity of the 12 compounds was directly related to the degree of alkyl substitution. In addition, naphthalene and its derivatives were more toxic than benzene and its derivatives, but less concentrated in the WSF.

CITATION : Mecklenburg, T.A., S.D. Rice, and J.F.Karinen. 1976. Molting and survival of king crab (*Paralithodes camtschatica*) and coonstripe shrimp (*Pandalus hypsinotus*) larvae exposed to Cook Inlet crude oil water-soluble fraction. in: D.A. Wolfe (ed.), Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms. Pergamon Press, New York, NY. pp. 221-228.

KEY-WORDS: Molting; Crustacea; Larvae; *Paralithodes camtschatica*; Crabs; Oil pollution.

SYNOPSIS : Larvae of coonstripe shrimp and king crab were exposed to solutions of the water-soluble fraction (WSF) of Cook Inlet crude oil in a series of bioassays on intermolt stages i and ii and the molt period from stage i to ii. Molting larvae were more sensitive than intermolt larvae to the WSF, and molting coonstripe shrimp larvae were more sensitive than molting king crab larvae. When molting larvae were exposed to high concentrations of the WSF (1.15-1.87% ppm total hydrocarbons) for as little as 6 hr, molting success was reduced by 1-30% and some deaths occurred. When larvae were exposed to these high concentrations for 24 hr or longer, molting declined 90-100% and the larvae usually died. The lowest concentrations tested (0.15-0.55 ppm total hydrocarbons) did not inhibit molting at any length of exposure, but many larvae died after molting. Median lethal concentrations (LC50's) based on 144 hr of observation for molting coonstripe shrimp and 120 hr for molting king crab were much lower than the 96-hr LC50's showing that the standard 96-hr LC50 is not always sufficient for determining acute oil toxicity. Although our LC50's for intermolt larvae are higher than levels of petroleum hydrocarbons reported for chronic and spill situations, some of our LC50's for molting larvae exposed 24 hr and longer are similar to or below these environmental levels. Comparisons of sensitivity to oil between different crustacean species or life stages should be based on animals tested in the same stage of the molt cycle, such as intermolt.

ACCESS # : 463, ARL

CITATION : Karinen, J.F., and S.D. Rice. 1974. Effects of Prudhoe Bay crude oil on molting Tanner crabs, *Chionoecetes bairdi*. Mar. Fish. Rev. 36(2): 31-37.

KEY-WORDS: Crabs; Molting; Toxicity; *Chionoecetes bairdi*; Oil pollution; Crustacea.

SYNOPSIS : Premolt and postmolt juvenile male Tanner crabs, *Chionoecetes bairdi*, from Alaska waters were exposed to Prudhoe Bay crude oil in static bioassays in laboratories. Crabs in both stages were similarly susceptible to crude oil; the estimated 48-hour TLM (medium tolerance limits) values were 0.56 ml oil/liter. Molting success decreased with increasing exposure of crabs to oil, and newly molted crabs autotomized limbs during exposure to oil. Relating the results of our study to the known behavior of crabs and the documented behavior of oil spills in the ocean suggest that oil spilled in Alaska waters would harm the Tanner crab resources. The impact on all crab resources of chronic low-level oil pollution from the ballast water discharged into Prince William Sound is unknown. This study further illustrates our present state of ignorance concerning the biological effects of oil in the marine environment.

ACCESS # : 464, ARL

CITATION : Neff, J.M., and J.W. Anderson. 1981. Response of marine animals to petroleum and specific petroleum hydrocarbons. Applied Science Publishers LTD, London. 177 pp.

KEY-WORDS: Marine mammals; Hydrocarbons; Pollution effects.

SYNOPSIS : A major research effort has been initiated in this country and abroad to assess the impacts of hydrocarbon inputs on marine organisms and ecosystems. Much laboratory research to date has concentrated on acute toxicity bioassays with one or a few oils, or petrochemicals, and selected species of marine organisms. Such bioassays, while important, are of limited value in judging the potential impact of long term, low level petroleum contamination of marine ecosystems. The laboratory at Texas A&M University, under contract to the American Petroleum Institute since 1972, has conducted extensive laboratory and field research concerning the effects of petroleum and specific petroleum hydrocarbons on marine organisms and ecosystems. The purpose of this volume is to summarize and review lethal and sublethal effects of oil on marine organisms, based on results of laboratory studies completed since the publication of an earlier report (Anderson, 1975).

ACCESS # : 465, USF&WS

CITATION : King, J.G., and G.A.Sanger. 1979. Oil vulnerability index for marine oriented birds. In: J.C.Bartonek and D.N.Nettleship, Conservation of Marine Birds of Northern North America. U.S. Dept. Int., Fish Wildl. Serv. Wildl.Res. Rep. 11. 319 pp.

KEY-WORDS: Seabirds; Oil pollution; Waterfowl; Survival factors; Management; Shorebirds.

SYNOPSIS : The 176 species of birds using marine habitats of the Northeast Pacific are graded on the basis of 20 factors that affect their survival. A score of 0, 1, 3, or 5, respectively, representing no, low, medium, or high significance is assigned for each factor. The total score is the Oil Vulnerability Index (OVI). The OVI's range from 1 to 100; an index of 100 indicating the greatest vulnerability. Using this system, one can rank the avifauna of different areas according to their vulnerability to environmental hazards as an aid in making management decisions.

ACCESS # : 466, USF&WS

CITATION : King, J.G., C.P. Dau, R.E. Gill, Jr, and L.M.Dresch. 1980. A quantitative catalogue of intertidal and near shore bird habitats of eastern Bering Sea. U.S. Fish Wildl. Serv., Juneau, Alaska. Unpublished report.

KEY-WORDS: Seabirds; Intertidal habitats; Shorebirds; Waterfowl.

SYNOPSIS : Bering Sea waterbird habitats include four types; the shallow usually near shore waters where diving birds can feed on the bottom, the sheltered waters of lagoons and confined bays, unvegetated tidal mud flats and beaches, and vegetated flats to the upper limit of normal storm surges. Each of these extends for hundreds of thousands of acres within the Bering Sea area. Waterfowl and shorebirds respond to this wealth of habitats by utilizing them in great numbers. The region is important for nesting, migrational staging, and wintering birds. The entire population of many species depends on this habitat resource and some species manage to survive year round within this region.

ACCESS # : 467, MMS

CITATION : Science Applications, Inc. 1980. Major References, North Aleutian Shelf Lease Area. For NOAA, Office of Marine Pollution Assessment, Alaska Office.

KEY-WORDS: Bibliography; North Aleutian Shelf; Biology; Oceanography.

SYNOPSIS : This bibliography contains 147 citations in physical oceanography and over 200 citations in biological oceanography. The sources are from the published literature and unpublished agency reports.

ACCESS # : 468, MMS

CITATION : Science Applications, Inc. 1981. North Aleutian Lease Area, Summary. 21 Plates. For NOAA, Office of Marine Pollution Assessment, Alaska Office.

KEY-WORDS: Biogeography; Climatology; North Aleutian Shelf; Sea ice; Food web; Geology; Habitat; Human use; Oceanography.

SYNOPSIS : Plates (21) are presented in this report which includes text summarizing conditions and resources of the North Aleutian Shelf Lease area, Sale .92.

ACCESS # : 469, NOAA

CITATION : Thorsteinson, L. (cd.). 1983. Proceedings of a Synthesis Meeting: North Aleutian Shelf and Possible consequences of Oil and Gas Development, Anchorage, Alaska. 9-11 March 1982. OCSEAP/NOAA. Unpubl. Manuscript.

KEY-WORDS: Northern Aleutian Shelf; Petroleum development; Biology; Crustacea; Bivalves; Circulation; Distribution; Ecology; Habitat; Invertebrates; Larvae; Marine mammals; Oceanography; Oil pollution; Productivity; Resource assessment; Salmon; Sublethal effects.

SYNOPSIS : Proceedings of a synthesis meeting are presented for the North Aleutian Shelf regions. Available knowledge is summarized and interpreted in light of planned oil and gas development of the region. Proposed development and environmental implications are reviewed. Topics included are the transport and fate of spilled oil, the coastal habitats and species of the North Aleutian Shelf, and fisheries resources of the area.

ACCESS # : 470, MMS

CITATION : Rice, S.D., D.A. Moles, J.F. Karinen, S. Kern, M.G. Carls, C.C. Brodersen, J.A. Gharrett, M.M. Babcock. 1983. A Comprehensive Review of all Oil-Effects Research on Alaskan Fish and Invertebrates Conducted by the Auke Bay Laboratories, 1970-1981. RU # 72. Final Report. OCSEAP/NOAA. (in press). 145 pp.

KEY-WORDS: Petroleum; Hydrocarbons; Fish; Invertebrates; Toxicity; Sublethal effects; Habitat; Port Valdez.

SYNOPSIS : This report reviews and summarizes all of the oil-effects research conducted by the Auke Bay Laboratory from the beginning in 1970 through 1981. Both published and unpublished results from 63 studies are included, regardless of funding source. Research is reviewed according to subject (e.g., toxicity, sublethal effects, studies at Port Valdez) and includes a bibliography and abstracts. The results from different studies should be compared with caution because of differences in methods used. The toxic nature of water-soluble fractions and classes of compounds was examined in several studies. A variety of biological and environmental variables affect sensitivity of Alaskan species. The rate and quantities of hydrocarbon uptake vary considerably between different compounds, tissues, life stages, and species. Oil and its components have a variety of sublethal effects that can ultimately affect population numbers. The toxicity of treated ballast water effluent at Port Valdez is rapidly diluted, and direct short-term toxic effects in the natural environment are not apparent. Because of rapid dilution and low toxicity, there appears to be little evidence that drilling muds can be an environment concern to sensitive larvae. Sensitivity of an organism in a laboratory study is different from vulnerability after an oil spill. Laboratory tests isolate one variable at a time; whereas oil spills have many variables operating at one time, and each spill is different and unique.

ACCESS # : 471, ARL

CITATION : Hameedi, M.J. (ed.). 1981. Proceedings of a synthesis meeting: The St. George Basin environment and possible consequences of planned offshore oil and gas development. Anchorage, Ak. April 28-30. U.S. Dept. of Commerce, NOAA, OMPA, OCSEAP, Juneau.

KEY-WORDS: St. George Basin; Resource assessment; Petroleum development. Environmental legislation.

SYNOPSIS : The Outer Continental Shelf Environmental Assessment Program (OCSEAP) investigators, other scientists conducting research in the southeastern Bering Sea, and managers of resources of the region met in Anchorage, Alaska, 28-30 April 1981. OCSEAP's and other data were used to: (1) describe the marine and coastal environments of the St. George Basin Lease Area; and (2) discuss and record environmental issues of concern and environmental consequences of the proposed oil and gas development, including effects of hypothetical cases of oil spills and other pollution incidents. These topics were also presented to help BLM in the preparation of the Draft Environmental Impact Statement for OCS Sale 70. The following topics were discussed in workshops and plenary sessions at the St. George Synthesis Meeting: 1) Pollutant transport mechanisms and the fate of spilled oil. 2) Environmental hazards and restrictions to petroleum technology and facilities. 3) Potential effects of oil and gas development on marine mammals, especially endangered species, with emphasis on key habitats such as Unimak Pass and the Pribilof islands. 4) Potential effects of development on the finfish resources and pelagic ecosystems, with emphasis on salmon, halibut, pollock, and yellowish sole fisheries. 5) Potential effects of development on marine and coastal birds, with emphasis on major colonies and foraging areas such as the Pribilof Islands region. 6) Potential effects of development on the shellfish resources and benthic ecosystem, with emphasis on king and Tanner Crab fisheries.

ACCESS # : 472, USF&WS

CITATION : Petersen, M.R., and R.E. Gill, Jr. 1982. Population and status of Emperor Geese along the north side of Alaska Peninsula. Wildfowl 33: 31-38.

KEY-WORDS: Emperor geese; Distribution; Age composition; Waterfowl.

SYNOPSIS : In conjunction with studies of waterfowl and shorebirds in the eastern Bering Sea region information was gathered on Emperor Geese. Here, the researchers (1) report the number and temporal occurrence of geese observed in Nelson lagoon; (2) evaluate the relative importance to geese of the major estuaries on the north side of the Alaska Peninsula; (3) assess age ratios and average brood sizes of geese during autumn migration along the Bering Sea coast and Alaska Peninsula; and (4) compare changes in numbers of geese estimated during censuses in spring and autumn from 1963 to 1981.

ACCESS # : 473, ARL

CITATION : Gill, R.E., Jr., and J.D. Hall. 1983. Use of nearshore and estuarine areas of the southeastern Bering Sea by gray whales (Eschrichtius robustus). Arctic 36(3): 275-281.

KEY-WORDS: Gray whale; Feeding behavior; Estuaries; Marine mammals.

SYNOPSIS : During spring aerial surveys of the coast of the southeastern Bering Sea significant numbers of gray whales were seen in nearshore waters along the north side of the Alaska Peninsula. Many (50-80%) of these animals were observed surfacing with trailing mud or lying on their sides when surfacing, characteristics both associated with feeding. A migration route close to shore (within 1-2 km) was used until whales neared Egegik Bay, where they began to head west 5-8 km offshore, across northern Bristol Bay. Smaller numbers of gray whales were present throughout summer in nearshore waters and estuaries along the north side of the Alaska Peninsula. At Nelson Lagoon, gray whales normally used the lagoon in spring, were absent during early summer, returned in mid-summer, and then were present until late November when they departed for the wintering grounds. Gray whales were present in the lagoon most often during periods of peak tidal flow; those that appeared to be feeding were oriented into the current. Three behaviors that appeared to be associated with feeding were observed: side-feeding from a stationary position within shallow waters of lagoon channels, diving within the lagoon and in nearshore waters, and elliptical side-feeding in the surf zone along the outer coast. Large crustaceans of the genus Crangon were available to them and probably eaten by gray whales at Nelson Lagoon.

ACCESS # : 474, ARL.

CITATION : North Pacific Fishery Management Council, 1982. Feeding habits, food requirements, and status of Bering Sea marine mammals. Annotated Bibliography. Council Document #19a. Anchorage, Alaska.

KEY-WORDS: Marine mammals; Bibliography; Gray whale; Bowhead whale; Whales; Fur seal; Sea Lion; Walrus; Harbor seal; Spotted seal; Ribbon seal; Ringed seal; Bearded seal; Sea otter; Beluga whale.

SYNOPSIS : Seven hundred twenty documents are annotated in this reference list. Most references deal directly with foods, distribution, density, and population status of Bering Sea marine mammals. For some species, little or no work has been done in the Bering Sea, and references to work done in other areas are included for analogy and comparison. Much of the work on food requirements and metabolic and reproductive physiology has been done with captive animals. For some species (e.g., northern fur seal), there is a great deal of literature; the papers included for these species summarize current understanding of pertinent information.

ACCESS # : 475, ARL.

CITATION : Bakkala, R., W.Hirschberger, K. King, 1979. The groundfish resources of the Eastern Bering Sea and Aleutian Islands regions. Marine Fisheries Review. 44:11(1-24).

KEY-WORDS: Commercial fisheries; Pacific cod; Demersal fish; Walleye pollock; Fisheries; Fisheries resources.

SYNOPSIS : This paper recounts the history of the major fisheries in the areas, and delimites the resources that will be available to the developing U.S. fishery. It reviews the history of past fisheries for groundfish in the Eastern Bering Sea and Aleutian Islands regions to illustrate methods and areas of fishing, species taken and the magnitude of catches, and the current conditions of "the resource.

ACCESS # : 476, NMFS, Anchorage.

CITATION : Higgins, B.E., 1978. An assessment of certain living resources and potential resource-use conflicts between commercial fisheries and petroleum development activities in outer Bristol Basin and Bristol Bay, Southeastern Bering Sea. Environmental Assessment Division. NMFS. Juneau, Alaska.

KEY-WORDS: Commercial fisheries; Development; Productivity; Herring; Red King crab; Tanner crab; Salmon; Pollock; Seals; Sea Lion; Whales; Shrimp; Snails; Fisheries resources; Pollution effects; Petroleum development; St. George Basin.

SYNOPSIS : This report evaluates certain commercial and biological uses of outer Bristol Basin and Bristol Bay that may conflict with petroleum development, documents the national and international importance of the area's renewable living resources, and proposes recommendations to minimize or avoid potential resource-use conflicts. Potential resource conflicts between petroleum development and commercial fishing include loss of fishing space, interference with fishing operations, loss of or damage to fishing gear, fouling of fishing gear by oil, and contamination of fish and shellfish of commercial importance. Potential biological impacts include habitat alteration or destruction, noise and human disturbance, and pollution by oil and other contaminants. Impacts could be most severe in spring-summer, particularly June-July, the significant reproductive and developmental period for many species, especially fish and shellfish with pelagic early life history stages. The primary recommendation is to establish a marine sanctuary in the Bristol Bay/St. George Basin area, including the Pribilof Islands and Unimak Pass, bounded on the west by the 300-fathom contour. Other recommendations propose to prohibit oil and gas leasing forever, continue to defer leasing, restrict the timing of oil and gas activities to late fall and winter, and conduct further studies prior to making decisions on developing the area's petroleum resources.

CITATION : Otto, R.S., 1981. Eastern Bering Sea crab fisheries. in: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. vol. II. 1037-1066. NOAA, distrib. by Univ. of Washington Press. Seattle, WA.

KEY-WORDS: Commercial fisheries; Commercially important species; Crabs; King crab; *Paralithodes camtschatica*; Tanner crab; *Chionoecetes*; Crustacea.

SYNOPSIS : Eastern Bering Sea fisheries for red king crab, blue king crab and Tanner crabs are among the most important sources of crab in the world. Eastern Bering Sea crab fisheries currently provide about 12% of world crab landings, and some 38% of domestic crab landings. Fully 50% of the landed value of the U.S. crab catch came from the eastern Bering Sea in 1978.

The history of eastern Bering Sea crab fisheries extends back to 1930, but substantial commercial efforts were not undertaken until the 1950's, when the king crab fisheries were developed. Tanner crab fisheries were developed during the 1960's. Japan and the Soviet Union had large crab fisheries in the eastern Bering Sea before the United States mounted a substantial effort. Foreign fisheries for king crabs ceased in 1974 and are now prohibited. Japan continues to fish Tanner crab in the eastern Bering Sea, but the Soviet Union left the fishery in 1971.

Record landings of crabs in the eastern Bering Sea over the past five years have prompted the development of one of the newest and most efficient U.S. fishing fleets. The economic future of eastern Bering Sea crab fisheries is clouded by forecast declines in the abundance of red king crab and continued low abundance of *Chionoecetes bairdi*. Development of new markets will be necessary if the *Chionoecetes opilio* stock is to be fully exploited. Without the further development of the C. *opilio* fishery, the importance of the eastern Bering Sea as a source of crab is likely to decline.

ACCESS # : 478, ARL.

CITATION : Bakkala, R., K. King, and W. Hirschberger, 1981. Commercial use and management of demersal fish. in: D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. ii. 1015-1036. NOAA, distrib. by Univ. Washington Press. Seattle, WA.

KEY-WORDS: Commercial fisheries; Fisheries; Fisheries management; Fisheries resources; Fisheries development; Demersal fish; History.

SYNOPSIS : This article traces the history of various demersal fisheries in the eastern Bering Sea through the pre-management peak harvest years to the recent establishment of the management of the resources. At their peak, landings of foreign fisheries in the eastern Bering Sea were among the world's largest, supplying more than 2 million mt of groundfish annually. As declines in abundance of the resources became evident in the 1970's, catch restrictions were placed on foreign fleets. Foreign catches in 1977 and 1978 ranged from 1.0 to 1.3 million mt.

Under the U.S. Fishery Conservation and Management Act of 1976, all fishery resources within 200 miles of the Alaskan coast were placed under U.S. jurisdiction. The objectives of the management plan developed for the region were four fold. The rebuilding of the Pacific Halibut resource was continued. The rebuilding of the groundfish resources to healthy levels capable of producing maximum sustainable yields was initiated. The promotion of the participation of the U.S. fisheries in the use of the resources was started. And the harvest of the resources by foreign fleets was allowed to continue when it was consistent with the first three objectives.

ACCESS # : 479, ARL.

CITATION : Ashwell I-Erickson, S. and J.R. Elsner, 1981. The energy cost of free existence for Bering Sea harbor and spotted seals. In: D.W. Hood and J.A. Calder (eds.), Eastern Bering Sea Shelf: Oceanography and Resources. Vol. 11, '869-900. NOAA, distrib. by Univ. Washington Press. Seattle, WA.

KEY-WORDS: Physiology; Feeding; Food requirements; Models; Harbor seal; Spotted seal; Prey items; Herring; **Caplin**; **Pollock**; Invertebrates;

SYNOPSIS : Energy flow models based on single-prey diets were developed to assess the net energy requirements of Bering Sea harbor and spotted seal populations from long-term studies of food intake and composition, food energy content and **digestibility**, and metabolic effects of temperature, feeding, exercise, molt and reproduction in several captives of each species. Caloric values of diets were directly proportional to fat content, ranging from 0.6 to 1% in **pollock** and from 5.1 to **18.5%** in herring. The mean digestible energy of **pollock** and herring was 96.7% of gross ingested energy, respectively, and the net mean energy flow available from both diets was 80.3% of gross energy. Air and water temperatures comparable to those in the natural environment fell within the **thermoneutral** zone of the seals. Basal metabolism of both seal species declined with age. Maximum metabolic effort in water was achieved with harbor seals carrying a weight load of 8 kg at an oxygen consumption rate of **32.8ml/kg rein**, a value approximately four times basal rate. Metabolism during molt in harbor seals was 83% of **pre-molt** levels. Reproductive energy costs were estimated at 240,000 and 220,000 Kcal/yr for individual harbor and spotted seals, **respectively**. The mean annual gross energy required by both populations combined was estimated at 560,000,000,000 Kcal, corresponding to an annual consumption of 81,000 mt of **pollock**, 51,700 mt of **caplin**, 37,300 mt of herring and 46,100 mt of Invertebrates, four important prey groups in the diets of these seals.

ACCESS # : 480, NMFS, Anchorage.

CITATION : National Marine Fisheries Service, 1980. Living marine resources and commercial fisheries relative to potential oil and gas development in the northern **Aleutian** shelf area (Tentative Sale No. 75). Northwest and Alaska Fisheries Center, Seattle, Washington. Inter-agency report.

KEY-WORDS: Fisheries; Productivity; Cetacean; Commercial fisheries; Crabs; Fisheries resources; Habitat; Oil pollution; Petroleum development; Pollution effects; Sea Ice; Models; **Unimak Pass**; **Crustacea**.

SYNOPSIS : This report supplements the biological, oceanographic, and commercial fisheries information contained in earlier NMFS reports (**Hagglins**, 1980), but does not provide as detailed a discussion of these topics as is contained in the other reports. Though previous reports discuss the anticipated problems of conflict between existing fisheries and oil and gas lease sale development, this report explores the fate of spilled oil in this area as a series of complex integrations between pack ice, wind events and local currents through the use of models. It also examines the important role of protected tidal flats and salt marshes in maintaining the high productivity of the Bristol Bay region and their vulnerability to spills. Similarly, the North **Aleutian** shelf area provides an important habitat for many species, some of which form the basis of existing or potential commercial fisheries (e.g., crabs, salmon, clams, **pollock**, cod). The area also provides important habitat for four species of endangered whales (e.g., gray, fin, right, and humpback), especially in the **Unimak Pass** area. This report urges that petroleum exploration and development be deferred until the risks to the marine resources and their habitats are more accurately assessed relative to the **area's** petroleum potential, and until safer technologies are available to reduce the **presumed** risks involved.